The Contribution of Research and Technology Organisations to Innovation and Knowledge Transfer

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Final Report

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1 Introduction and Aims

1.1 Introduction

1.1.1 In October 2003 the Economic and Social Research Council (ESRC) on behalf of HM Treasury, the Department of Trade and Industry (DTI) and the Inland Revenue commissioned the ESRC Centre for Business Research (CBR) at the University of Cambridge, Public & Corporate Economic Consultants (PACEC), and the Institute for Fiscal Studies (IFS) to carry out research on the role of Research and Technology Organisations (RTOs). The focus was on the contribution of RTOs to innovation and knowledge transfer and the influence of fiscal policies and taxation on their activities.

1.1.2 The background to the project is the premise that technology-based innovation in the UK is a complex system, including a diverse array of:

a Companies (multinational, UK 'middle market' and smaller growing enterprises),

b Research-base organisations (universities, Research Council Institutes, public sector research establishments), and

c Research and Technology Organisations (RTOs).

1.1.3 The role of each of these groups, and the sub-groups within them, is changing. Commercial R&D faces new financial pressures in many sectors, while the longer term imperative to innovate in order to retain value added activities in the UK is becoming stronger for many sectors.

1.1.4 In addition, the government has significantly developed its fiscal policies with respect to RTOs and the tax incentives for scientific research, and research and development. There are a number of incentives including Section 508 (under the Income and Corporation Taxes Act 1988), capital allowances for R&D expenditure and R&D tax credits. The government has also conducted a major consultation exercise aimed at resolving the definition of R&D and eligibility criteria for tax relief.

1.2 The Specific Aims of the Project

1.2.1 Within this context the project was designed to:

- Map the role of RTOs in the UK, sector by sector, identifying their linkages with the research base on the one hand, and companies applying technology-based innovation on the other.
- Assess the scale and nature of the impact of RTOs on commercial innovation, identifying different modes of operation and the potential for 'spill-over' benefits which may not be fully captured by the RTO and its contractual counterparts.
- Explore the impact of the various tax regimes applying to different types of RTOs on their ability to sustain and invest in their technology capabilities. Within this context, the following questions should also be addressed:
  - To what extent do current tax exemption/relief measures encourage knowledge transfer?

- What are the interactions between the tax exemption/relief measures based on the nature of the organisation undertaking the activity and those based on the type of activity undertaken?
- What would be the impact of using the definition of R&D used for tax credits for all R&D exemption/relief measures?
- What are the economically-valid boundaries for the use of R&D tax exemption/relief measures?
- How valid is the research spill over rationale for the application of tax exemption/relief in the value-chain from idea to [value-added] application, with the aim of improving wealth creation through innovation in the UK economy?

1.3 The Research Methodology

1.3.1 To address the issues, an integrated research programme has been designed with HMT, DTI, and IR, and implemented as follows:

a Discussions with HTM, DTI and IR on the issues, the population of RTOs and their characteristics, the nature of the tax regime, incentives, and procedures

b A desk study on the activities of the RTOs: their number, and coverage by industrial sector and/or technologies

c Interviews with AIRTO as the industry body representing RTOs and some thirty individual RTOs. These interviews covered a group with tax exemption under section 508, referred to as exempt RTOs (ERTOs) and a comparison group of those without, non exempt RTOs (NERTOs)

d A telephone survey of some 90 firms who use RTO services mainly as members of the associations, providers of contract R&D, testing and prototyping services and consultancy or recipients of information through publications or events. A comparison survey of some 60 firms with similar characteristics but do not use RTOs

e Interviews with other intermediaries, mainly universities, who contribute to the science base and RTO activity

f The development and deployment of a model which explored the impact of the tax regime on the activities of RTOs

1.3.2 The research explored common themes for each group of organisations which allowed their responses to be compared. The interviews with RTOs and firms who use their services provide qualitative outputs, while the tax model is a quantitative assessment of the influence of the tax regime on R&D.

1.4 The Structure of the Report

1.4.1 Following this introduction Chapter 2 considers the role of the RTOs in principle and draws on secondary and primary sources and the surveys with RTOs and firms to assess their role in practice. Chapter 2 also introduces the rationale for supporting this role through the tax system. Chapter 3 proceeds to look at the structure of the UK tax system for R&D for RTOs, setting out some of the tax relief available and eligibility for these, including section 508 relief for Scientific Research Associations, corporation income taxes, R&D tax relief and R&D tax credits, and general capital allowances. Chapter 4 provides a tax modelling exercise to demonstrate the impact

of the tax system on research and development. Chapter 5 draws conclusions and addresses the specific issues of the brief. An annex to the report shows the principle activities of RTOs.

2 The Role of RTOs in the UK Innovation System

2.1 Introduction

2.1.1 This chapter looks at the role of the RTOs in the UK Innovation System. It will consider firstly the role of the RTOs in principle and the rationale for supporting this role through the tax system. It will then go on to assess the role of RTOs in practice, looking firstly at the size of the RTO community and their contribution to R&D in the UK. Drawing on the surveys with RTOs and firms, and discussions with universities, the final sections will look at the services RTOs provide to firms and the impact this has on innovation, R&D, and performance of firms.

2.2 The RTO Community

2.2.1 Mapping the role of Research and Technology Organisations in the UK system of innovation requires a working definition within which to collate and assess relevant data.

2.2.2 The Invitation to Tender distinguishes three types of organisation:

- Companies including multinationals, middle market and smaller enterprises
- Research base organisations such as Universities, Research Councils and public sector research establishments
- Research and Technology Organisations (RTOs)

2.2.3 The implication of this classification is that RTOs can be distinguished readily from the private commercial sector and the publicly funded research base. This distinction is usually framed in terms of an intermediary role between the latter two. Thus in the recent DTI Innovation Report [1], RTOs are defined as 'technology intermediaries', and their main activities are summarized as:

- Support for company innovation champions by providing in-sourcing expertise, business models and technology to increase productivity
- 'Translating' and managing the integration process of 'raw' knowledge into applications in a way understood by management
- Working with universities
  - to develop ideas and competences into a form attractive to second stage funding
  - to optimize contract spin out and licensing activities
- Auditing organisations to uncover exploitable innovation assets
- Raising R&D capability in low R&D organisations

[1] *Competing in the Global Economy: the innovation challenge,* DTI London December 2003 $ 3.39-$3.42 pp.63-4

2.2.4 The report posits an important role for RTOs in developing and implementing the Technology Strategy proposed in the review. It notes in particular their role in the proposed structure of Knowledge Transfer Networks[2]. These networks are one of the five 'products' through which DTI support for technological innovation will be available. These knowledge transfer networks build upon the collaborative Faraday Partnerships which connect universities and RTOs with business and finance in key areas of technology.

2.2.5 A further definition of RTO is provided by AIRTO which stands for both Applied Industrial Research Trading Organisations and for the Association of Independent Research and Technology Organisations (website http://www.airto.co.uk).

2.2.6 AIRTO's mission in relation to independent research and technology organisations is to:

- Stimulate knowledge sharing by networking and benchmarking
- Improve the market climate for the trading activities of their members
- Increase demand in industry and government for AIRTO member expertise
- Provide AIRTO member collective views to industry leaders, UK government and the EU on knowledge transfer in the private sector

2.2.7 AIRTO defines their members as 'value adding traders in knowledge', with in-depth specialist knowledge of either sectors or technologies. This reinforces the intermediation role identified in the DTI innovation report. AIRTO members are further defined as engaged in *for-profit* activities including

- Techno-business consultancy
- Single-client, or multiple-client contract research
- Accreditation and testing services to international acceptance and accreditation standards
- Skills training and conferences
- Technology and management information services including bibliographic and database resources
- Individual and collective early stage funding and incubation activities

2.2.8 This list includes research and experimental development activities which overlap with those carried out in both the public sector science base organisations and in the commercial sector, for instance the R&D consultancy and R&D Services sectors. This diversity is reflected in the organisational forms adopted by AIRTO members, which include both for-profit and not-for-profit forms and holding company structures with subsidiaries operating both for-profit and not-for-profit purposes. These reflect the interaction between the tax system and the development of organisational forms that will best meet the purposes for which they are designed.

[2] *Competing in the Global Economy: the innovation challenge*, DTI London December 2003 $3.32 p 62.

2.2.9 AIRTO membership includes a particular group of RTOs which Section 508 of the Income and Corporation Tax Act 1988 defines, for tax exemption purposes, as Scientific Research Associations (SRAs). For expositional purposes we will refer to these as ERTOs (*E*xempt RTOs) and to other RTOs as NERTOs *N*on-*E*xempt RTOs). The term RTO will mean both ERTOs and NERTOs.

2.2.10 ERTOs in terms of Section 508 of the Act are essentially *not-for-profit* associations having the *sole* object of undertaking scientific research which may lead to an extension of any class or classes of trade. Scientific research for this purpose is in turn defined as the:

- Application of new scientific principles in an existing area of research
- Application of existing scientific principles in a new area of research

2.2.11 This approach in principle excludes the applications of existing principles in existing areas which is treated as technological rather than scientific research. It also excludes organisations which provide a range of innovation service activities such as knowledge transfer or the dissemination of knowledge which are frequently included in wider discussions of the role of Research and Technology Organisations. It also appears to limit the extent to which activities benefit a single company rather than a 'class of trade' and hence the conduct of contract research. The details of this categorization and its interrelationship with the tax system are a major concern of this report and are considered in detail in chapters 3 and 4 below.

2.2.12 Estimating the scale and impact of the RTO sector is not straightforward. The AIRTO website reports over 50 members, with a joint turnover of £1billion and science and engineer employment of 10,000 and reports figures for the 'collective authority' of the AIRTO community of over 20,000 scientists and an annual turnover of over £2billion (cited in the DTI innovation report). It is not clear why this figure is so much higher.

2.2.13 We attempted to derive an estimate of RTO activity based upon the company accounts of RTOs deposited at Companies House. Our sampling frame consisted of a current membership list from the AIRTO website, a membership list for 2001 which AIRTO made available to us, along with a list of a small number of other RTOs provided by a consultant to the sector. This yielded a list of 46 RTOs. For each of these we tried wherever possible to identify the consolidated accounts appropriate to the RTO activity for the latest year available and for the prior year. We used these accounts to measure employment, research and technology employment, turnover and s508 exempt status. Since exemption under s508 is retrospective it is not easy to define ERTO status precisely since some accounts will state they are in the process of applying and some shown as having exempt status may have since lost it or not applied for it. Since some RTOs are small enough to have entitlement to submit abbreviated accounts it was not always possible to obtain the full data required. In general our estimates will be an underestimate since apart from companies submitting abbreviated accounts not all companies report employment data. Moreover where RTOs are not organised as companies they will not appear in the Companies House records.

2.2.14 In all we obtained information for 46 RTO companies of which, in financial year 2002-03, 11 were ERTOs and 35 NERTOs. Qinetiq, the largest RTO is substantially larger than all the other RTOs and skews all the data on the scale of the RTO community, figures for Qinetiq are therefore not included in the table below but are commented on in the text. Table 2.1 shows that turnover for this group was £489 million £501 million in 2002 excluding Qinetiq, and £1.2 billion in 2001 and £1.1 billion in 2002 including Qinetiq. These estimates are very close to the lower of the two estimates referred to above. The table also shows total employment of around 6,000 and researcher employment of around 3,400. This is lower than the figure reported by DTI and largely reflects the fact that we were unable to breakdown the employment data for Qinetiq, the largest RTO. Qinetiq employs around 10,000 staff. If 7,000 of them are scientists and engineers, then our sample employment estimates would be, for 2002, 16,000 employees and over 10,000 scientists, very close to the AIRTO estimates.

Table 2.1 RTO Turnover and Employment, 2001 and 2002

	ERTO		NERTO		Total
	No.	%	No.	%	No.
RTOs	11	23.9	34[1]	76.1	45[1]
			2002		
Turnover £000	179,800	14.1	320,901	85.9	500,701
Employment	3,100	50.8	2,998	49.2	6,098
Researchers	1,855	54.2	1,569	45.8	3,424
			2001		
Turnover £000	176,287	15.4	312,555	84.6	488,842
Employment	3,073	52.7	2,763	47.3	5,836
Researchers	1,876	55.4	1,513	44.6	3,389

Source: Company Accounts
[1] Excludes Qinetiq

2.2.15 The definition of scientists and engineers used in these estimates is not provided in the DTI or AIRTO sources nor in the company accounts data. As a rough order of magnitude it may be noted that the total number of 'researchers' engaged on R&D in the business enterprise sector is around 86,000, and in government departments and the research councils combined is around 30,000[3]. This suggests that the RTOs we have identified, (the vast majority of which are in AIRTO) account for around 5% of private business sector science and engineering employment in R&D activities in the UK, or an estimated 15% including Qinetiq. An alternative way of estimating the significance of RTO research employment is to compare the RTO research employment data with the total R&D employment in those SIC sectors to which RTOs

[3] (J. Morgan 'Research and Development Statistics 2000' *Economic Trends* No 585 August 2002 Table 12 p.53).

are classified in the UK R&D statistics. These sectors are principally research and development services, computer related services, and technical testing and analysis. Around 30,000 were employed on R&D in these sectors in 2002 so research employment in the RTOs accounts for 15% of this total excluding Qinetiq and around a third including Qinetiq. This is clearly a significant contribution.

2.2.16 Neither the company accounts data nor AIRTO sources give complete data on R&D expenditure by the RTOs. However our survey of RTOs, discussed below, showed among the 22 organisations which provided an estimate, total R&D expenditure of £60 million (15% of turnover) excluding Qinetiq. Grossed up for all 46 identified RTOs this would suggest R&D spending in the region of £80 to £85 million excluding Qinetiq. As an indication of the significance of RTO contribution to total R&D spending, extramural expenditure on R&D in the UK by UK businesses in 2002 in the R&D services, computer related services, and technical testing and analysis sectors was £90 million. On the basis of the estimates above, RTO spending on R&D accounts for approximately 6-8% of the £1294 million total extramural expenditure on R&D in the UK by UK businesses[4] excluding Qinetiq. This reiterates the significance of RTOs activities.

2.2.17 Despite the fact that significant amounts of data on ERTOs are collected as part of the regulatory process it has not been possible for confidentiality reasons to utilise any official data relating to their scale or scope. An analysis by the project team of AIRTO member company returns to Companies House, AIRTO membership lists, interviews with the Inland Revenue and the DTI, and our own survey of AIRTO members (set out in detail below) suggest that currently there are around 10-15 successful applications for exemptions each year with a combined turnover of between £150 and £250million. The current estimate of the value of the tax exemption relief to ERTOs provided to the team by HM Inland Revenue is less than £3million (see chapter 3) This suggests that they are a small part of overall RTO activity. Table 2.1 reveals that we could only identify 11 ERTOs from information in the accounts data and that they are relatively small in turnover terms but much more significant in terms of research employment which is consistent with the nature of their exempt status.

2.2.18 The role of RTOs in the innovation system in the UK is reflected not only in terms of the magnitude of their resource inputs into R&D. Their role is also reflected in the extent to which they contribute to and participate in aspects of UK policy development and implementation. Thus the DTI Innovation Report notes (p.62) that 27 independent RTOs are involved in the 25 Faraday Partnerships which have been set up in the last 5 years. The pattern of this interaction is captured in Table 2.2, which is based on an examination of the relevant Faraday and individual RTO websites.

[4] ('Research and Development in UK Businesses', *Business Monitor* MA14: Data for 2002, London, The Stationary Office, 2003 Table 6 p15)

Table 2.2 Faraday Partnerships

Faraday Partnership	Description	Partnership Website	RTO Core Partners
ADVANCE	Automotive and Aerospace materials	www.faraday-advance.net	MIRA
COMIT	Communications and Mobile Information Technology	www.comit.uk.com	Quinitiq
CRYSTAL	Green Technology for the Chemical and Allied Industry	www.crystalfaraday.org	
EPPIC	Electronics and Photonics Packaging and Interconnection	www.eppic-faraday.com	ITRI TWI
FIRST	Innovative Remediation Science and Technology	www.firstfaraday.com	PERA
Food Processing	Developing the underpinning materials, equipment and process knowledge applicable to food processing	www.pera.com/foodfaraday/index.asp	PERA Leatherhead Food International
Genesis	Farm Animal Genetics and Genomics	www.genesis-faraday.org	
High Power RF	Industrial applications of high power radio frequency engineering	www.powerfaraday.org.uk	CCLRC TWI
Imaging	Digital Imaging	www.imagingfp.org.uk	SIRA
IMPACT	Innovative Materials Development and Product Formulation by the application of Colloid Technology	www.impactfp.org	CCFRA
Industrial Mathematics and System Engineering	Industrial Mathematics and System Engineering	www.smithinst.ac.uk	Smith Institute
INREB	Integration of new and renewable energy in buildings	www.inreb.org	BRE
Insight	High throughput technologies for new product and process development	www.insightfaraday.org	LGC
Intersect	Intelligent sensors for control technologies	www.intersect.org.uk	SIRA NPL
Medical Devices	Medical Devices	www.medical-devices-faraday.com	TWI
Mini-waste	Novel Technologies and processes for the minimisation of industrial waste	www.mini-waste.com	
Packaging	Practical Innovation for fast-moving consumer goods (fmcg) packaging, its manufacture and supply	www.faradaypackaging.com	PIRA
Pinpoint	Global navigation satellite systems (GNSS) applications	www.pinpoint-faraday.org.uk	NPL
Plastics	Enabling research to meet the critical technological challenges of the plastics sector	www.faraday-plastics.com	RAPRA
PRIME	Smart Products (products with inter-dependent mechanical and electronic parts)	www.primefaraday.org.uk	PERA
Pro-Bio	Bio-catalytic processes for manufacturing	www.pro-bio-faraday.com	BHR

PowdermatriX	Rapid manufacturing through powder processes	www.powdermatrix.org	CERAM NPL
Smart Optics	Smart Optics	www.smartoptics.org	SIRA
Technitex	Technical textiles	www.technitex.hw.ac.uk	BTTG

2.2.19 AIRTO members themselves cover an even wider sectoral range than the Faraday network. This is shown in Table 2.3.

Table 2.3 Sector Coverage of RTOs

Name (Initial)	Name (Full)	RTO SIC code	Main Sector Covered by RTO members (2 digit SIC)
ADVANTICA	Advantica Technologies Ltd	7310	Electricity, Gas, Water
AMTRI	AMTRI	7310	Mechanical Engineering
ARA	Aircraft Research Association Ltd	7310	Aerospace
BHRA	BHR Group Limited	7310	Electricity, Gas, Water
BLC	BLC Leather Technology Centre	7310 7430	Leather
BMT	British Maritime Technology Ltd	7310 6322 6321 6323	Transport
BRE	Building Research Establishment	7310	Construction
BRI	Brewing Research International	7310 7487	Drink
BSRIA	The Building Services Research and Information Association	7310	Construction
BTTG	British Textile Technology Group	7310 7430	Made Up Textiles
CCFRA	Campden & Chorleywood Food Research Association	7310	Food and Drink
CERAM	British Ceramic Research Limited	7310	Man. Non Metallic Minerals
CIRIA	Construction Industry Research & Information Association	7310	Construction
CLRC	CLRC - Rutherford Appleton Laboratory		Misc.
FIRA	FIRA International Ltd	7430 7420	Furniture
HRL	HR Wallingford Groups Ltd	7487	Architecture and Engineering
IST	Institute of Spring Technology	7310 9112	Metal Goods
ITRI	ITRI Ltd	9305	Basic Metals
LFI	Leatherhead Food International	9305	Food and Drink
LGC	Laboratory of the Government Chemist		Misc.
MERL	Materials Engineering Research Laboratory Limited	7420	Rubber and Plastics
MIRA	Motor Industry Research Association Ltd	9999	Motor Vehicles
MIRO	Mineral Industry Research Organisation	7310	Extraction and Processing
MIRRC	Motor Insurance Repair	7310	Motor Repairs

	Research Centre		
NCC	National Computing Centre Ltd	7220 7260 7310 7413	Misc.
NCIMB	National Collections of Industrial and Marine Bacteria Ltd	7310	Misc.
NPL	National Physical Laboratory	7499	Misc.
PERA	PERA	7487	Manufacturing
PIRA	PIRA International	2215 7414 7482 7430	Printing and Publishing
PRA	Paint Research Association	7310 7430 7487	Other Chemicals
QinetiQ	QuinetiQ Group Ltd	7415	Defence
RAPRA	RAPRA	7310 7499	Rubber and Plastics
SATRA	SATRA	7310	Made Up Textiles
SCI	Steel Construction Institute	7310	Construction
Sira	Sira Ltd	7310	Instruments
Smith Institute	Smith Institute	7310	Misc.
STRI	Sports Turf Institute	7310	Agriculture
SWRI	Scottish Whisky Research Institute	7310	Man. Drink
TNO	TNO BIBRA International Ltd	7310	Medical
TRADA	TRADA Technology Ltd	7310 7487 7420	Wood
TRF	Transport Research Foundation	7310	Transport
TWI	TWI	7310 7487 8021	Mechanical Engineering
WRC	WRC	7310 7420 7487	Electricity, Gas, Water

2.3 Spillovers and the Rationale for Subsidising the Activities of RTOs

2.3.1 RTOs in the UK are involved directly, and through their intermediation role, indirectly in scientific research and in research and experimental development activity. A particular feature of the mode of operation of these organisations is that they are in the main membership based organisations which promote collaborative as well as single client linked activities. The ERTO category is specifically targeted at the scientific research and collaborative end of the spectrum. These characteristics suggest several ways in which, in principle, a case for subsidization of RTO activities, and within that ERTO activities, could be made.

2.3.2 It is widely recognized that the overall benefit that society enjoys from R&D activity exceeds the private returns gained by the firms who carry it out and who innovate as result of that activity. The social rate of return to R&D in principle and in practice therefore exceeds the private rate of return. The 'spillover' benefits to society which are represented by the gap between the social and private rates of return are not reflected in the gains from R&D and innovation appropriated by the private sector. Left to itself the private market will not therefore fully capture the social value of the investment in R&D activity and the level of R&D and innovation will be less than optimal.

2.3.3 Spillover benefits arise in several ways. Jaffe (1996)[5], for instance, distinguishes between;

- 'knowledge spillovers' which can arise from both basic research and applied research and development as a result of voluntary dissemination of findings (e.g.publications) or other mechanisms such as reverse engineering of products by competitors
- 'market spillovers' which arise when market forces prevent innovators from capturing the full benefit of their improved product or process offerings because it is passed on in lower prices/higher quality to consumers or producers who purchase them,
- 'network spillovers' which arise when the gain to a firm from its R&D activities is strongly interdependent with activities by other firms with similar or complementary technologies e.g. the interdependence between the value of a software platform and the development of applications for it, or the development of common standards within which a technology will be developed.

Knowledge spillovers

2.3.4 The gains from knowledge spillovers are particularly relevant in the case of RTOs. Scientific research, especially where the results are widely disseminated, is very likely to generate knowledge spillovers. To the extent that RTOs allow groups of firms to fund collaborative research and share the resulting information, they enable groups of firms to internalise these externalities. Apart from helping to overcome the considerable difficulties involved in establishing these types of cooperative arrangements in the first place, justification for further support on the basis of knowledge spillovers must rest on there being further benefits to firms outside the group. This is quite likely since other firms may have an incentive to "free-ride" on the research results without contributing to the costs.

2.3.5 It is important to note that raising the level of research effort and dissemination may not only raise firms' level of original or novel innovation but also their ability to imitate innovations introduced by others, and to introduce incremental innovation changes in-house. Incremental and diffusion innovations are powerful mechanisms by which

[5] For a useful succinct overview in relation to a major US public sector support programme for applied research and technology activity see Jaffe,A.B. Economic Analysis of Research Spillovers Impliatioons for the Advanced Technology Programme December 1996 (http://www.atp.nist.gov/eao/gcr708.htm)

the average level of performance is raised in the aftermath of original more novel innovative activity.

Network spillovers

2.3.6 The extent to which RTO activities generate network spillovers depends upon the extent to which a single firm is limited in its ability to either handle all of the components in-house or effectively sub-contract for those parts it cannot. The more complex the interaction required and the more difficult sub-contracting becomes because of the problems of coordinating investment commitments between different firms then the more important collective networking relationships become.

2.3.7 It is generally acknowledged that over time the complexity of technological advances and the interdependence of R&D activity is raising the extent to which such collaborative efforts are involved. The extent and effectiveness of these networking and collaborative activities has thus become a central feature of private sector business performance and public sector innovation policy. This is reflected in the widespread development of joint venture and related collaborations in the private sector as well as the development of public programmes to help identify and resolve coordination and network problems. The ability of RTOs to help identify and resolve some of these coordination problems through their activities is therefore an important aspect of their role in overcoming the problems of network spillovers.

2.3.8 Since the formation of organisations such as an RTOs themselves involves private cost to those who seek to establish them, and yet who will not reap their full benefit, there is an important seedcorn role for public funding in assisting their formation. This is separate from the argument that, once founded, their activities may yield benefits which reach beyond their members by virtue of knowledge or network spillovers, or which will be undertaken as a group for group benefit but would not have occurred if each firm sought purely to act independently.

Activities of RTOs

2.3.9 It is likely that not all activities of RTOs generate spillovers, so any government support should be targeted at those activities which are most likely to have spillover benefits. For example, for collaborative R&D, and especially R&D where the results are widely disseminated, the knowledge spillover rationale for intervention is especially relevant. In contrast, knowledge transfer activities that simply involve testing under existing standards, or paying for access to existing information, are less likely to suffer from spillover related market failures other than inadequate provision of information.

2.3.10 In our survey based empirical analysis we attempt to identify the main activities of RTOs and their members which may be associated with knowledge based and network spillovers. Our analysis of this information is then combined in chapters 3 and 4 with an analysis of the current system of tax subsidy for R&D generally and for ERTO activity in particular.

2.4 Survey Respondents and the RTO Community

2.4.1 In view of the lack of detailed information about the sector, the recognized significance of AIRTO and in the absence of any sampling frame for ERTOs we undertook an interview based survey of the RTO sample described in Table 2.1 above.

2.4.2 Table 2.4 sets out the extent to which our respondents correspond with that sample. It shows that we obtained 29 interview responses and that the organisations interviewed accounted for around 57% of NERTOs and 80% of ERTOs.

2.4.3 The table also shows that the respondents accounted for the vast majority of the turnover and employment reported in the companies house files, even excluding Qinetiq. This is partly due to the presence of Qinetiq which is by far the largest RTO and was a respondent. If we exclude Qinetiq the sample still accounts for 88% of turnover, 77% of employment and 68% of research employment of the Company Accounts RTO sample.

Table 2.4 The Significance of the Sample RTOs, 2002

	ERTO	NERTO	Total
RTOs Surveyed. No.	9	20	29
Proportion of Companies House samples. %	81.8%	57.1%	63.0%
	Surveyed RTOs as a proportion of the Companies House RTO sample[1]		
Turnover £000. %	80.8	88.5%	85.7%
Employment. %	83.0	76.8%	80.0%
Researchers. %	75.5	67.9%	72.0%

Source: Company Accounts
Note: [1] Not all RTOs provided all the data required in their accounts. The percentages reflect those which did relative to the totals for all RTOs for which company accounts were available and are reported in Table 2.1 above. The data excludes Qinetiq.

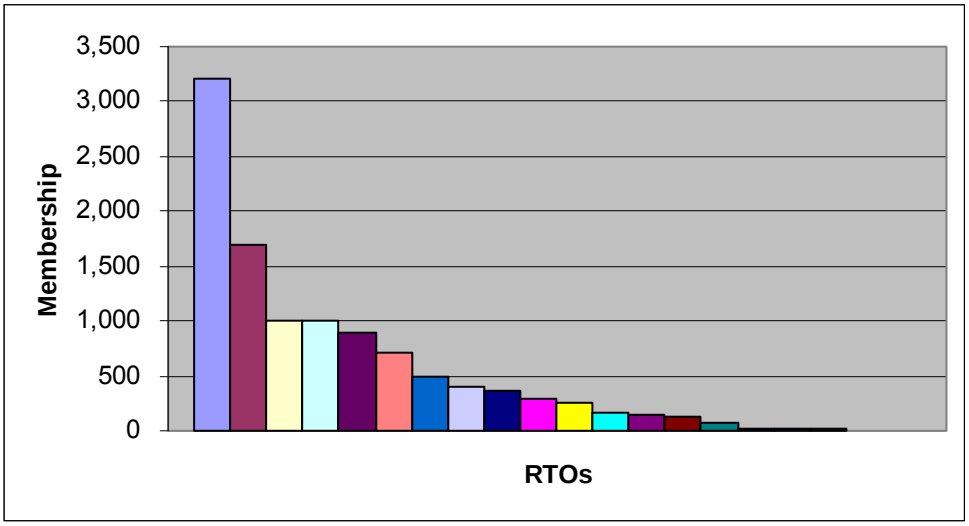
2.4.4 In our discussion of the survey results which follow we note whenever the presence of Qinetiq may distort results. We also divide the results into ERTO and NERTO on the basis of the interview survey responses themselves rather than the company accounts data so as to provide the most up to date context for the responses. Ten of the 29 RTOs we have spoken to currently claim tax exemption under section 508. We anticipate this is most of the organisations currently claiming tax exemption under section 508.

2.5 Background and Characteristics of the Surveyed RTOs

2.5.1 Seventy percent of the RTOs have membership schemes, this is all of the ERTOs and half of the other RTOs. Figure 2.1 shows that the size of the membership base varies considerably with a median membership of 275 members and a mean membership of 544 members. On the whole ERTOs tend to have a larger membership base than NERTOs. The largest organisation has over 3000 members

whilst around half have less than 250 members. Those with very few members do not offer membership services but have members for legal reasons.

Figure 2.1 RTO Membership Distribution



Source: PACEC Survey (q14)

2.5.2 For most organisations a substantial proportion, and in a minority of cases, a majority of their membership is from outside the UK. Most RTOs, with members, claimed that membership was stable or it had increased over the past three years (especially amongst ERTOs) in recent years. Around half considered that their membership was reasonably representative of the UK industry/sectors they provided services for. Where it was not it was mainly because many firms in the sector were small and/or did not carry out R&D or did not use consultancy or testing facilities. Table 2.5 shows that member firms are mainly medium and large firms, reflecting the comments above, the very many small and micro businesses in some sectors are not captured within RTO membership.

Table 2.5 Is your membership representative of the UK industry you serve?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Yes	56	56	57
No	38	33	43
Don't know	6	11	0
Number of respondents	*16*	*9*	*7*

Source: PACEC Survey (q112a)

2.5.3 The size of RTOs in employment terms also varies enormously, ranging from just six employees to almost 10,000. The greatest variation is amongst the NERTOs, a majority of ERTOs have between 100 and 250 employees.

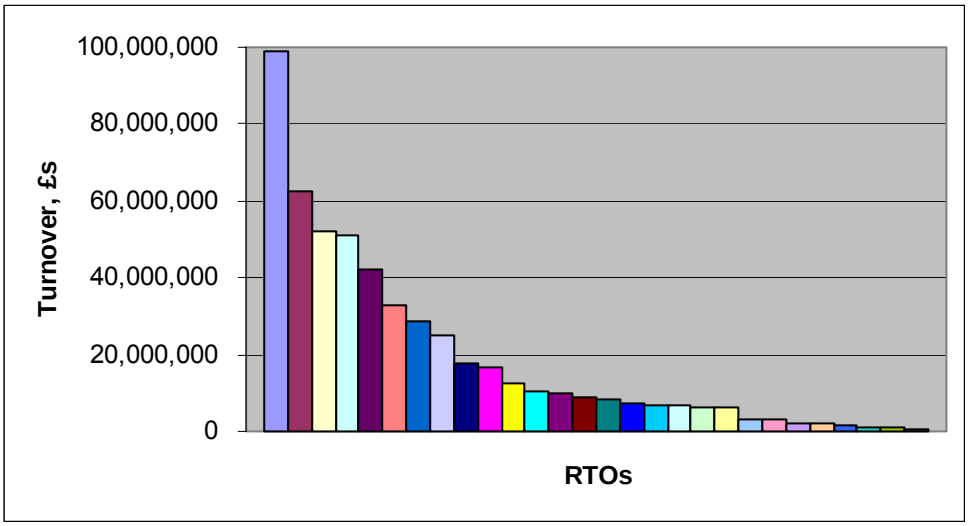
Table 2.6 How many people does the organisation / company employ?

	Statistics of all respondents. (by S508 Status)[2]		
	Total	ERTO[1]	NERTO
Median	143	165	138
Mean	280	207	321
Min	6	50	6
Max	700	420	700
Number of respondents	*29*	*10*	*19*

Source: PACEC Survey (Q6)
Notes: [1] Where possible the data refers to the whole group
[2] Excludes the largest RTO

2.5.4 Taking the turnover of all RTOs in their last operating year (with different monthly ends in 2003), the minimum was £0.7m with the maximum of £800m. The median was £9.1m with the mean of £18.8m (excluding the largest RTO). The ERTOs had a minimum turnover of £2.3m and a maximum of £33.0m. NERTOs had a wider range (and there were several smaller than the smallest ERTO).

Table 2.7 Turnover of RTOs[1] (£m) Last Operating Year



Source: PACEC Survey (Q48a)
Note: [1]excludes the largest RTO

2.5.5 Income came from a range of sources for the RTOs whether or not they had tax exemption. On average taking all RTOs the main source of income was consultancy (ie 22%) followed by testing and prototyping services (ie 20%). On average, around 10% came from contract research for the public sector, collaborative research using public sector funds (eg Link or TCS) and contract research for the private sector. The pattern was similar for ERTOs and NERTOs. The exception was ERTOs which tended to undertake more contract and collaborative research with private sector (ie membership) funds and less with public sector funds, while NERTOs derive more private sector income from consultancy and testing.

Table 2.8 If we take the most recent year can you say what the sources of income have been?

	Average (mean) of all respondents. (by S508 Status)		
	Total	ERTO	NERTO
Consultancy	21.6	14.7	26.2
Providing facilities / prototyping / testing	19.1	14.0	22.6
Collaborative research (with public sector funds)	9.3	**7.3**	10.7
Contract research(private sector)	8.4	**15.2**	3.9
Contract research(public sector)	8.3	**4.1**	11.1
Exploitation of products / processes	6.8	16.1	0.7
Membership fees	6.2	6.4	6.1
Collaborative research (with private sector funds)	5.1	**7.3**	3.7
Training	3.1	4.9	1.9
Publications	2.4	0.3	3.7
Conferences / Networks	2.3	1.1	3.1
Other	7.5	8.7	6.7
Number of respondents	*25*	*10*	*15*

Source: PACEC Survey (q49)

2.5.6 The share of income from collaborative research with public sector funds averaged 9% for ERTOs and 12% for NERTOs. However, the minimum was no use of these funds while the maximum comprised some 67% of income in the NERTO sector.

2.5.7 The most popular organisational form is a company limited by guarantee. Other NERTOs are private companies limited by shares or employee benefit trust companies.

2.5.8 Overall NERTOs organisations tend to be smaller than ERTOs in membership, employment and turnover, although there is much more variation amongst NERTOs. Two thirds of NERTOs have previously claimed tax exemption. A significant minority of these retain the structure and profile of activities that would allow them to claim, and mostly don't apply for exemption at the moment because of a recent history of forecast of losses.

2.5.9 We look in more depth at the income and activities of RTOs in Chapter 4 when we assess the interaction of this tax system with the expenditure patterns and structure of income. We note here, however, that in the last financial year for which data were available, one third of the surveyed RTOs made losses.

2.6 Aims and Activities of RTOs

2.6.1 The survey confirms that the aims of the RTOs are concerned in broad terms with the development of knowledge and technology, its application and commercial exploitation. The development of knowledge and technology is usually through undertaking pure or scientific research (usually in collaboration), with a more

significant input by a minority of RTOs, through to research and development (under contract or through collaboration) for all of the RTOs. Application and exploitation is linked to the R&D and underpinned by a range of consulting, brokerage, prototyping, and testing services. Dissemination occurs at one level through these activities, in the short term via the collaboration activities, and the programme of events and publications. Hence RTOs aim to offer services, insights, and ideas, at all stages of the value chain. Their corporate and group aims are to grow, show "reasonable" profits and build shareholder value.

2.6.2 There is an even split of organisations focussing on a particular science or technology and a particular industry, although all the RTOs target their services at industry. The ERTOs tend to retain a focus on a particular industry (60%). NERTOs are more likely to focus on a science / technology and serve a wider range of industries.

Table 2.9 Does your organisation focus more on a particular science /technology or a particular industry(s)?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Science/Technology	45	30	53
Industry	45	60	37
Both	7	10	5
Other	3	0	5
Number of respondents	*29*	*10*	*19*

Source: PACEC Survey (q18a)

2.6.3 0 below shows the sector and technology coverage of the RTOs, the membership of the RTO and an indication of the number of British firms in the sector, broken down by size. This gives some indication of the strengths of RTOs however it must be borne in mind that RTOs have a wider client base than their members. It should also be noted that it has not been possible to disaggregate the membership of RTOs across the different sectors served.

Sector and Technology Coverage of RTOs

	RTOs Citing Sector	Combined Membership of RTOs [1]	Total Firms in Sector, GB, 2002			
Sector			Total	Small	Medium	Large
Aerospace	5	4017	856	647	126	83
Apparel	1	900	5560	5369	165	26
Automotive	2	213	3206	2630	369	207
Ceramics	1	300	1074	962	83	29
Chemicals	2	160	4691	3812	609	270
Civil Engineering	1	16	73671	71807	1537	327
Construction	3	1513	193999	190910	2623	466
Defence	3	20	1626	1305	195	126
Electrical Appliances	1	143	602	511	59	32
Energy	5	166	2029	1523	318	188
Engineering	1	400	20314	18446	1472	396
Finance	2	1000	47359	44270	2191	898
Food/Drink (manufacture)	6	2023	9901	8362	992	547
Footwear	1	900	403	349	42	12
Furniture	1	900	7685	7197	375	113
Healthcare	1	20	43767	39224	3595	948
Leather Production	1	500	151	140	8	3
Leather Retail	1	500	8916	8866	48	2
Manufacture of leather goods	1	500	845	777	55	13
Manufacturing	3	1015	175316	162433	10006	2877
Medical Devices	1	143	1906	1777	111	18
Paper	1		2771	2303	393	75
Pharmaceuticals	3	643	631	462	79	90
Printing	1	16	20837	20191	553	93
Public Sector	1	250	187527	163477	20351	3699
Publishing	2	1000	10828	10314	367	147
Retail	1	250	291770	283763	5837	2170
Security	1	1000	2105	1980	106	19
Spring manufacture	1		606	539	60	7
Telecoms	1	360	10865	10054	505	306
Transport	1	3	77663	74451	2434	778
Water and Waste Water Treatment	2	143	1111	952	116	43
Technology						
Aerodynamics	1	4				
Built Environment	1	400				
Chemistry	2	1860				
Clean Technologies	2	900				
Computing/IT	3	1400				
Engineering	3	16				

Environmental Hydraulics	1	16
Fluid Engineering	1	
Food Science/ Technology	2	400
Forensic Science	1	
Joining Processes	1	3200
Manufacturing Technology	2	415
Materials Science	1	300
Mathematics	1	
Microbiology	2	1700
Pesticides	1	
Physics	1	
Polymers	2	543
Treatment techniques	1	500

[1] The majority of RTOs cited more than one sector. It has not been possible to disaggregate membership by sector. Not all RTOs have members and all will serve a wider client base.
Source: PACEC Survey (q19 and 20); ABI, 2002, ONS

2.6.4 All the RTOs need to demonstrate the that they lead on and respond to the market on technology requirements, some examples of RTOs adapting to changing industrial context and demands are increased activity across the RTOs where technologies are becoming cross cutting and integrated, such as wider networks, the application of technology in new product markets, and greater steps to increase market intelligence. Some areas of new technology for RTOs are materials forming, integrated computing and security systems, and food processing and its interface with electronics and engineering.

2.6.5 Table 2.10 shows the activities provided by the RTO sector including those provided by tax exempt parent companies and subsidiary companies. The most commonly offered services and activities are:

a Consultancy services, this will often include trouble shooting and failure diagnosis

b Contract research for the private sector of a more strategic nature

c Collaborative research programmes such as those funded by DTI and European Framework programme

d Training

e New product, service and process development

f Testing and analytical services

2.6.6 On the whole some of the less offered activities are:

a Commercial exploitation of new development such as licensing agreements and strategic partnerships /ventures;

b Hosting post graduate research

c Setting industry standards.

2.6.7 Some areas of significant difference between ERTOs and NERTOs are in:

a Pure, scientific research, which as we might expect, is more common amongst ERTOs

b Contract research for the public sector, which is more common amongst NERTOs organisations, perhaps reflecting some of the industries and sectors this group serves, eg construction / built environment and defence

2.6.8 There was little difference between the two groups in their engagement in collaborative research with a majority of both groups managing and undertaking publicly funded collaborative research, and a majority of both groups undertaking collaborative research paid for with private sector funds from clients or members. For NERTOs this is more commonly applied research or market research than basic / scientific research.

Table 2.10 What activities / services do you provide?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO[1]	NERTO
Own internal research	45	40	47
Pure research	41	60	32
Contract research (private sector)	90	80	95
Contract research (public sector)	72	50	84
Collaborative research (with private sector funds)	76	80	74
Collaborative research (with public sector funds)	86	70	95
Managing collaborative research	69	80	63
Consultancy	90	80	95
Technology brokerage	48	60	42
Training	83	70	89
Conferences	72	70	74
Networks	55	70	47
Public research	72	80	68
Other dissemination	45	60	37
New product/service development	79	80	79
New process development	72	50	84
Prototyping	41	60	32
Testing/test facilities and certification	72	70	74
Evaluation	55	40	63
Commercial application / exploitation	41	40	42
Strategic Partnerships / Ventures	31	30	32
Obtain patents / IPR	45	30	53
Licence agreements	31	20	37
General Advice	66	70	63
Enquiry Service	66	80	58
Library / abstract service	62	70	58
Briefing / newsletter	59	60	58
Post graduate research	31	20	37
Setting industry standards	21	20	21
Other	24	10	32
Number of respondents	*29*	*10*	*19*

Source: PACEC Survey (q22)
Note:[1] This refers to the whole group, not the tax exempt body alone.

2.6.9 Amongst ERTOs there is a division on the activities between the parent body which is exempt from tax and their subsidiary companies (Table 2.11). The tax exempt parent bodies undertake:

- Pure research
- Collaborative research with private sector funds
- Managing collaborative research, and

- Facilitating networks

2.6.10 Subsidiary companies undertake:

- Contract research
- Collaborative research with public sector funds
- Consultancy
- Training
- Testing and other support for commercial exploitation

2.6.11 Advice, enquiry and briefing services are undertaken by a mixture of parent and subsidiary companies.

Table 2.11 Activities / services of ERTOs and Subsidiaries

	Number of respondents	
	Tax Exempt Parent	Subsidiary
Own internal research	3	1
Pure research	6	1
Contract research (private sector)	1	7
Contract research (public sector)	1	6
Collaborative research (with private sector funds)	7	7
Collaborative research (with public sector funds)	3	4
Managing collaborative research	6	4
Consultancy	0	8
Technology brokerage	0	6
Training	2	7
Conferences	5	4
Networks	6	4
Public research	5	5
Other dissemination	4	3
New product/service development	0	8
New process development	0	5
Prototyping	1	5
Testing/test facilities and certification	1	9
Evaluation	0	4
Commercial application / exploitation	0	4
Strategic Partnerships / Ventures	0	3
Obtain patents / IPR	0	3
Licence agreements	0	2
General Advice	5	4
Enquiry Service	7	4
Library / abstract service	5	4
Briefing / newsletter	5	4
Post graduate research	1	2
Setting industry standards	0	2
Other	0	1
Number of respondents	10	8

Source: PACEC Survey (q22)

2.6.12 The extent to which these patterns of activities are reflected in R&D expenditure is discussed in detail in Chapter 4 in relation to the tax system. It is important to note here, however, that the relative research intensity of ERTOs is reflected in the fact that the median ratio of R&D to overall expenditure is 22% for that group, compared to around 10% for NERTOs.

Publicly Funded Collaborative Research

2.6.13 All but two of the RTOs participate to some extent in collaborative research programmes, although for some this is a peripheral activity.

2.6.14 The most commonly used programmes are European Framework 6 (74%), Link (56%), and Faraday (52%). Fifteen of the RTOs surveyed are core partners in a Faraday Partnership and receive funding for infrastructure, managing and facilitating the partnership. A wide variety of other programmes are used including Partners in Innovation and Carrier Technologies (DTI), CRAFT (EU) and funding from other government departments and agencies, particularly DEFRA and associated agencies such as the Food Standards Agency.

2.6.15 Such activities contribute two thirds of the income of one RTO but more typically around ten percent of income and for some of the more commercial RTOs less than one percent.

Table 2.12 Which public sector funds are used?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Faraday	52	50	53
Foresight	11	10	12
Link	56	60	53
Foresight link	30	40	24
Smart	19	0	29
TCS / KTPs	33	40	29
Other DTI	44	60	35
Research Council	22	30	18
European Framework	74	80	71
Other EU	19	20	18
Other	44	60	35
Number of respondents	*27*	*10*	*17*

Source: PACEC Survey (q25a)

2.6.16 For most of these projects the RTO will have initiated and led the project, developed the proposal and brought the partnership together. In fewer cases the RTO may have been asked by others to coordinate and lead the project or be a partner in a project managed by an other agency.

Table 2.13 What is your role in the project(s)?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Initiate and Lead	94	86	100
Coordinate and Lead	61	86	45
Partner	56	71	45
Number of respondents	*18*	*7*	*11*

Source: PACEC Survey (q27a)

2.6.17 Other participants in these projects are mostly universities (82%) and members (36%) or other firms (55%). For some schemes the RTO themselves can participate as a commercial partner and may collaborate with other RTOs on a project.

2.6.18 The main beneficiaries of collaborative research projects are perceived to be firms and RTO members, followed by universities, research organisations, the government, and those such as the RTO who have participated directly in the project.

Table 2.14 Who are usually the main beneficiaries of the projects (eg firms, research groups, individuals), and how do they benefit?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Firms	76	100	64
Members	52	71	43
Universities	33	57	21
Government	33	43	29
Research organisations	29	43	21
Consumers	19	14	21
Other	10	14	7
Participants / Partners	10	14	7
The RTO	19	14	21
Number of respondents	*21*	*7*	*14*

Source: PACEC Survey (q32a)

2.6.19 In order to address the question of whether there are spill over effects of collaborative research projects the RTOs were asked whether there would be wider beneficiaries not directly involved in these activities. All respondents felt the benefits of collaborative projects did spill over to other beneficiaries, mainly other firms, but also universities and the government.

2.6.20 The additionality of the RTOs involvement in collaborative research programmes was sought by asking respondents to what extent they thought the benefits of the project would have occurred without their involvement. The vast majority of the organisations perceived that the benefits would not have occurred to the same extent without their involvement in the project. In the main this was felt to be because the

ideas were generated and project created by the RTO, or because of RTOs strong links with industry which ensures that projects address industry needs and are disseminated widely. Only one respondent was rather pessimistic about the benefits of RTOs.

Table 2.15 To what extent do you think these benefits would have occurred without your involvement in collaborative projects?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
To the same extent	14	0	21
To a limited extent	48	57	43
Not at all	38	43	36
Number of respondents	*21*	*7*	*14*

Source: PACEC Survey (q34a)

Privately Funded Collaborative and Scientific Research

2.6.21 All of the ERTOs undertake scientific research, mainly collaboratively with or for members, but also within their own research and development programme. Less than half of NERTOs offer this service and tend to concentrate on applied or commercial research such as consumer research and market trends.

Table 2.16 Do you undertake any scientific research which is not funded by public sector grants (and is not privately contracted)?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Yes	64	**100**	44
No	36	**0**	56
Number of respondents	*25*	*9*	*16*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q89a)

2.6.22 These activities are all led by the RTO, for ERTOs and membership based organisations a research panel of members determine and direct the project aims and focus. Other organisations may approach clients directly or produce a prospectus of potential projects to offer clients.

2.6.23 Firms, members and research organisations are felt to be the main beneficiaries of the research, followed in a minority of cases by consumers / the general public. In the majority of cases these projects will have wider beneficiaries in other firms and research organisations.

Table 2.17 Who are usually the main beneficiaries of the projects (eg members, firms, research groups, individuals), and how do they benefit?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Firms	83	83	83
Research organisations	58	67	50
Members	58	83	33
Universities	50	67	33
Government	50	50	50
Consumers	17	33	0
Number of respondents	*12*	*6*	*6*

Source: PACEC Survey (q97a)

2.6.24 A critical issue is whether the scientific research carried out by the RTOs (especially ERTOs) stimulates other activities. All but one of RTOs said this was the case. The main activities stimulated in the ERTOs were further interest in research, help to set the research agenda, and making it easier to attract members. In the subsidiaries, the scientific research in the parent tax exempt companies stimulated collaborative R&D, exploitation and commercialisation (to some extent by the RTO), consultancy/brokerage and dissemination.

2.6.25 In order to address the question of whether there are spill over effects of scientific research the RTOs were asked whether there would be wider beneficiaries not directly involved in these activities. Almost all the RTOs (and especially ERTOs) considered that there would be wider beneficiaries not directly involved in these activities but benefits of the spill over would be limited. These were mainly other RTOs and firms (and members) together with the universities and government departments.

2.6.26 The majority of respondents felt these activities were largely additional with the benefits occurring only to a limited extent without the RTOs involvement.

2.6.27 ERTOs were asked to what extent they thought their involvement in some key activities would change if tax exemption under section 508 did not exist, these were scientific research, other research and development, collaboration, and membership services. For the most part it was felt that the other research, collaboration and membership services would continue at the same level, however all but one of the respondents felt they would undertake less scientific research in the absence of section 508.

2.7 Commercial Exploitation by RTOs

2.7.1 Three quarters of RTOs seek to commercially exploit the knowledge and technology developed within the organisation. For most RTOs this will be the development of new products or a combination of new product and new service development, but for

one or two this is only or mainly the development of new or a wider range of services. This section focuses on the exploitation of tangible products.

Table 2.18 Is your organisation involved in the commercial exploitation of research and technology for the organisation?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Yes	77	75	78
No	23	25	22
Number of respondents	*26*	*8*	*18*

Source: PACEC Survey (q41)

2.7.2 Table 2.19 shows the main methods used by RTOs to exploit technology. Over half do so themselves selling products directly to clients, and half use licensing agreements. Other methods include joint ventures, for example with a software development company, developing IPR and selling the products through third parties, and new entities.

Table 2.19 What are the methods used?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Directly by RTO	56	80	46
Licensing agreements	50	60	46
Developing Intellectual Property rights and ownership	33	20	38
New services	33	0	46
New entities	28	0	38
Joint venture	22	0	31
Other	6	0	8
Number of respondents	*18*	*5*	*13*

Source: PACEC Survey (q42b)

2.7.3 Ninety percent of RTOs involved in exploitation will initiate and lead some projects, 50% will coordinate and lead some projects, and relatively few will be a partner in a project led by others.

Table 2.20 What is the role / activity of the organisation?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Initiate and Lead	90	100	86
Coordinate and Lead	50	**100**	29
Partner	50	33	57
Number of respondents	*10*	*3*	*7*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q43a)

2.7.4 Bringing products to market is felt to have wider beneficiaries by 85% of respondents; these are typically firms and research organisations.

2.7.5 Almost 90% of respondents consider that similar projects or benefits would have occurred only to a limited extent or not at all without the involvement of the RTO.

Table 2.21 To what extent do you think these projects / commercialisation would have occurred without involvement of your organisation?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
To the same extent	17	17	17
To a limited extent	50	67	33
Not at all	33	17	50
Number of respondents	*12*	*6*	*6*

Source: PACEC Survey (q47a)

Commercial Exploitation by Non RTOs

2.7.6 Almost all the RTOs (especially ERTOs) said that the knowledge and technology developed by them through their activities with firms was usually exploited commercially to some degree by firms over time. The time scale and form of exploitation varied and although not all the commercial applications were entirely successful, knowledge was accumulated.

Table 2.22 Is knowledge and technology developed by you exploited commercially by others?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Yes	86	89	85
No	14	11	15
Number of respondents	*22*	*9*	*13*

Source: PACEC Survey (q101)

2.7.7 The main contribution to this, and the involvement of the RTOs, was mainly through sub-contract research and consultancy/brokerage which was close to market and resulted mainly in new products with some impact on the development of processes.

Table 2.23 What is your involvement?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Sub contract research	79	100	67
New product development	53	57	50
New process development	42	43	42
Testing/prototyping	32	14	42
Consultancy	37	57	25
Brokerage	32	43	25
Other	5	0	8
Number of respondents	*19*	*7*	*12*

Source: PACEC Survey (q103b)

2.7.8 Firms usually exploited the technology directly or in the form of spin outs and new entities. It was considered that ultimately there were wider benefits and spillover effects as the technology captured in products and processes became transparent and "public".

2.7.9 Most of the RTOs said that the development in technology and exploitation would have occurred to some extent (or to a limited extent) without their involvement. About a third thought exploitation would have occurred to the same extent in the absence of their involvement.

Knowledge Transfer and Dissemination

2.7.10 All but one of the organisations considered it was involved in the transfer and dissemination of knowledge, although interpretations of knowledge transfer varied. For many this is not a discrete activity but an integral part of all of their work. This is illustrated in the high position of 'consultancy' in the table below which shows the main methods used.

Table 2.24 What are the methods used?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Workshops	57	40	67
Consultancy	43	40	44
ICT / web dissemination	29	40	22
Conferences	21	40	11
Training	14	20	11
Networks	14	20	11
Brokerage	14	20	11
Exchange people	7	0	11
Publish Research	7	20	0
Other	29	20	33
Number of respondents	*14*	*5*	*9*

Source: PACEC Survey (q36a)

2.7.11 The most effective methods were felt to be those which allow some personal contact, such as consultancy and workshops, and ICT /web dissemination which can efficiently make information available to many people within an organisation.

2.7.12 Overwhelmingly the main beneficiaries of knowledge transfer are firms (83%) and members ERTOs.

Table 2.25 Who will be the main beneficiaries? How will they benefit?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Firms	83	100	79
Research organisations	39	50	36
Universities	33	50	29
Individuals	17	25	14
Members	44	75	36
Consumers	6	25	0
Government	33	50	29
Number of respondents	*18*	*4*	*14*

Source: PACEC Survey (q39a)

2.7.13 The additionality of the benefits of these activities is felt to be high with over ninety percent of respondents considering they would have occurred only to a limited extent or not at all but for the RTOs activities. The main reason for this is felt to be RTOs strong links with industry.

Table 2.26 To what extent do you think these benefits would have occurred without your activities?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
To the same extent	6	0	10
To a limited extent	82	71	90
Not at all	12	29	0
Number of respondents	*17*	*7*	*10*

Source: PACEC Survey (q40a)

2.8 The Users and Use of RTOs

2.8.1 The survey of firms is inevitably influenced by the difficulties of acquiring contact details for firms. The survey relied on contact details for industrial members being provided by the RTOs. Due to data confidentiality, commercial confidentiality and other considerations many of the RTOs felt unable to provide details of firm. Contact details were provided by eight RTOs (TWi, CCFRA, Leatherhead Food International, SIRA, PERA, BLC Leather Technology, BMT, Smith Institute). Mostly details were of a small selection of members with significant involvement with the RTO and had agreed to participate. It is therefore important to recognise that the survey is not of a representative group but is of an illustrative group of RTO members. From the contacts provided 91 responses were achieved.

2.8.2 The survey of firms shows that the users of RTOs services are mainly but not exclusively engaged in manufacturing, 66%. Wholesale, retail, repair and other (non-business) services are the next most significant sectors among the sample.

Table 2.27 What is the main activity at this site?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
Manufacturing	66	59	54	**75**
Other service	13	18	15	**5**
Wholesale, retail, repair	7	**18**	8	4
Electricity, gas and water supply	4	0	0	7
Transport & communication	3	0	8	4
Financial intermediation	2	0	15	0
Business support, real estate	2	6	0	2
Public admin, defence	1	0	0	2
Health and social work	1	0	0	2
Number of respondents	*90*	*17*	*13*	*55*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q6b)

2.8.3 Two thirds of the respondents are large firms employing 250 or more staff. Small firms of up to 50 employees are particularly underrepresented in the sample, less than 20% of respondents. Almost 90% of firms considered themselves to be 'mature', with almost a third of small firm 'going for growth'.

Table 2.28 Including any part-time workers and working directors, how many people does your firm employ?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
1 to 50	19	100	0	0
51 to 250	17	0	100	0
251 and over	64	0	0	100
Number of respondents	*86*	*17*	*13*	*56*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q8bnd)

2.8.4 Table 2.29 shows the main RTO services used by firms and the types of involvement. Over half of the respondents are members and have been involved in collaborative projects, training/conference/events, and used consultancy services. Further questions on knowledge transfer activities show that use of conference and events are considerably higher than use of other training, and also that visits from RTO staff are an important element of knowledge transfer. There is no significant difference in the use of services by size of firm.

2.8.5 Discussions with the RTOs suggest that use of RTOs services reach far wider than their members and that membership and involvement in collaborative research projects are probably disproportionately high amongst the contact provided. Other forms of involvement tend to be greater personal involvement from an individual such as sitting on advisory panels.

Table 2.29 How have you been involved with the RTO?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
Collaborative research project	70	65	69	71
Member	65	59	62	64
Consultancy	55	59	69	54
Training/conferences/events	55	53	69	48
Networks	49	47	62	45
Contract research	26	18	38	29
Commercial application / exploitation support	20	24	23	20
Strategic Partnerships/Ventures	16	24	15	16
Other	13	12	15	14
Number of respondents	*91*	*17*	*13*	*56*

Source: PACEC Survey (q17a)

2.8.6 Keeping abreast of technology and industry development and networking are the main objectives and rationale for involvement with an RTO. Strengthening R&D capabilities and access to technical support and expertise are more important among small and medium firms than large firms.

Table 2.30 What were your aims in becoming involved?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
Keep abreast of technology developments	62	44	67	65
Keep abreast of industry developments	61	**38**	67	67
Networking	59	**38**	67	58
Improve technical skills	57	44	50	65
Strengthen R&D capabilities	55	63	67	51
Get new ideas	50	38	50	56
Develop new product/process/material/service	50	44	25	58
Early access to new technology	46	31	58	47
Improve product/process/material/service	43	44	42	44
Overcome a technical problem	41	31	33	49
Gain a competitive edge	39	38	42	40
Improve other skills	34	25	25	42
Early access to new product/process/material	28	25	42	28
Other	22	13	25	26
Number of respondents	*74*	*16*	*12*	*43*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q18a)

2.9 The Impact of RTOs for Firms

2.9.1 Table 2.31 provides a summary of firms' perceptions of the improvement in the activities, skills and capabilities of the firm as a result of involvement with the RTO. Firms were asked whether the impact of the project or event(s) they were involved in was 'substantial', 'moderate', 'none' or 'too early / don't know'. The table below shows the percentage of respondents identifying a substantial change for four areas of activity.

2.9.2 The table shows the greatest impact of most activities is perceived to have been on the ability to innovate and adopt new technology, and on technical skills and capabilities. In general there has been less impact on introducing new products / services and processes or improving existing products / services / processes with one fifth of firms reporting no change in these areas regardless of the nature of the project or activity. However amongst the relatively small number of firms involved in

a commercial exploitation project this has had a substantial effect on products / services / processes for over a third of firms.

2.9.3 The table confirms and illustrates the arguments earlier in the chapter on the importance of the diffusion and dissemination of knowledge generated through research. Knowledge transfer, through visits, conferences, events and other dissemination, and to a slightly lesser degree, collaborative research projects, have a more substantial impact on small firms than large firms.

Table 2.31 Impact on capabilities and skills, respondents reporting a 'substantial' impact

	Percentage of all respondents			
	Collaborative Research	Knowledge Transfer	Consultancy	Commercial Exploitation
Percentage respondents involved	75	76	44	25
R&D capabilities	27	29	9	31
Technical capabilities	28	31	18	41
Improved technical skills	30	32	18	35
Improved other skills	15	22	18	31
Introduced new processes	25	28	20	38
Improved existing processes	23	26	27	35
Introduced new products / services	23	28	9	31
Improved quality of products / services	21	27	9	41
Ability to innovate	30	34	9	50
Ability to adopt new technology	32	34	9	44
Number of respondents	*67*	*67*	*11*	*19*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey

2.9.4 The above suggests that RTOs make an important contribution to improving innovation and R&D capabilities of firms. To assess the additionality of the role of RTOs, firms were asked to what extent these improvements would have happened anyway, without being involved in an event or project with the RTO and whether they would have taken alternative steps to in the absence of the RTO.

2.9.5 Table 2.32 shows the extent to which firms perceived the improvements as wholly additional, ie would not have happened at all without involvement in an event or project. The table suggest there is a reasonably high degree of additionality, particularly with commercial exploitation projects.

Table 2.32 Extent to which this impact would have occurred without involvement with an RTO, respondents reporting 'not at all'.

	Percentage of all respondents			
	Collaborative Research	Knowledge Transfer	Consultancy	Commercial Exploitation
Total	25	18	0	39
1 to 50 employees	17	33	0	50
51 to 250 employees	**56**	**57**	0	33
Over 250 employees	23	10	0	38
Number of respondents	*64*	*65*	*9*	*18*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q18a)

2.9.6 Table 2.33 also indicates the improvements were wholly additional for around one fifth of firms who reported that they would not have taken any alternative steps to achieve these improvements.

Table 2.33 Would you have taken alternative steps to achieve these effects in the absence of the RTO? Respondents reporting 'definitely or probably not'.

	Percentage of all respondents			
	Collaborative Research	Knowledge Transfer	Consultancy	Commercial Exploitation
Total	21	25	9	12
1 to 50 employees	25	40	50	50
51 to 250 employees	25	57	0	0
Over 250 employees	19	15	0	9
Number of respondents	*63*	*65*	*11*	*16*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q23)

2.9.7 Less than half of the firm consulted felt able to comment on the impact of involvement with the RTO on their business performance. Amongst those who could comment just under one third considered there had been an increase in turnover and export but only ten percent considered there had been an increase in employment as a result of involvement with the RTO.

Table 2.34 How has the performance of your business changed as a result of your involvement with the RTO? Respondents reporting 'increase'.

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
Turnover	29	0	57	26
Exports	29	33	33	28
Employment	11	0	0	15
Number of respondents	*38*	*3*	*7*	*27*

Source: PACEC Survey (q38a)

2.10 Use of Other Research Organisations and Perceptions of RTOs

2.10.1 Over 90% of firms had used other organisations for support with innovation and R&D, however there is a significant difference between small and medium firms and large firms in this respect, with 100% of large firm using other organisations compared with 75% of small and medium firms. Universities were the most commonly used alternative (91%), followed some way behind by consultancies (45%). Other companies in the sector and suppliers were also cited.

Table 2.35 Have you used any other organisation in undertaking R&D?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
Yes	92	80	**69**	**100**
No	8	20	**31**	**0**
Number of respondents	*83*	*15*	*13*	*51*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q52a)

Table 2.36 What kind of organisations?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
University	91	83	90	94
Consultancy	45	33	40	51
Other RTO	26	17	20	29
Other	21	17	20	22
Number of respondents	*77*	*12*	*10*	*51*

Source: PACEC Survey (q52b)

2.10.2 For most working with universities, consultancies and others has been less beneficial than working with an RTO. Consultancies were felt to be expensive and lacking in practical or specialist knowledge. Universities were felt to lack commercial understanding and did not operate to appropriate timescales for businesses. On the

other hand universities were felt to do more research and innovation than RTOs, have greater expertise and are more likely to sell IPR than RTOs.

2.10.3 Ninety percent of firms believed the RTOs to have particular strengths over others. The main strengths can be summed up as 'specialist knowledge with practical application'. Other strengths were having skills in the sector, a business like and business friendly approach, and offering good networking opportunities. Just under half of firm also identified some particular weaknesses of RTOs, two common weaknesses were 'lack of knowledge in specific sector' and 'expensive'.

2.10.4 The vast majority of firms who use RTO services consider the RTOs are significant in promoting innovation (Table 2.37).

Table 2.37 Overall, how significant do you think RTOs are in promoting innovation in your sector?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
Very significant	51	50	46	47
Some significance	41	31	46	47
Not at all	5	6	8	4
Don't know	3	13	0	2
Number of respondents	*87*	*16*	*13*	*53*

Source: PACEC Survey (q43a)

2.11 Comparison Group Survey of Non-RTO User Firms

2.11.1 The comparison group survey of non RTO member firms is drawn from a matching sample to the survey of RTO members. The sampling frame for the comparison group survey was the Business Select database and a sample of firms which mirrored the size (employees) and sector (two digit SIC code) of respondents to the RTO users survey. The comparison group is therefore not a representative sample of all businesses but a comparison sample of respondents to the survey of RTO members. Similarly the comparison group is over representative of large firms and certain sectors. It is also worth highlighting that in taking a matching sample the comparison group firms are drawn from sectors in which at least one RTO operates.

2.11.2 The comparison group survey sought to compare the experience of firms using external sources of support for R&D other than RTOs with those of the firms above. Responses were received from 68 companies, some eleven of which were found to be RTO members and have been excluded from the results. This gives full responses for comparative purposes from 57 companies. A further 38 businesses did not use any external sources of support for R&D and were asked a small subset of the questions.

2.11.3 Table 2.38 and Table 2.39 show that whilst the respondents in the comparison group of firms are very similar in sector to those in RTO Users group, overall a greater percentage of non users are small firms.

Table 2.38 Main Sectors of RTO Users and Comparison Group Firms

	Percentage of all respondents	
	RTO Users	Comparison Group
Manuf: Food and drink	21	20
Manuf: Machinery and equipment	12	13
Other business activities	12	4
Manuf: Leather and footwear	10	2
Manuf: Chemicals	6	9
Manuf: Other transport	4	7
Manuf: Other non-metallic	3	7
Manuf: Rubber and plastics	2	7
Other	30	31
Number of respondents	*89*	*54*

Source: PACEC Survey (q43a)

Table 2.39 Including any part-time workers and working directors, how many people does your firm employ?

	Percentage of all respondents	
	RTO Users	Comparison Group
1 to 50	19	27
51 to 250	15	14
251 and over	65	60
Number of respondents	*86*	*52*

2.11.4 The main alternative sources of support used by the comparison groups of firms were universities (48%), consultancies, and other companies in the sector/ suppliers. A fifth of firms, mainly large firms, have had some involvement with an RTO but are not a member. This demonstrates the value of RTO activities, which reach beyond their membership.

2.11.5 Table 2.40 shows the nature of support or firms involvement with these supporting organisations. The main uses of support from other organisations is Collaborative Research Projects (45% compared with 75% of RTO users, Training/ Conferences/ Events (45% compared with 55% of RTO users) – particularly among small and medium firms, and Consultancy (30% compared with 55%). Support for commercial application / exploitation is particularly low amongst the comparison group firms (7%). Overall these lower percentages suggest less comprehensive use of alternative sources of support than RTOs, ie each firm is engaged in fewer types of support with the provider.

Table 2.40 Support or Involvement by Type of Organisation

	Percentage of all respondents			
	Total	University	Consultancy	RTO
Collaborative research project	45	56	53	64
Contract research	20	28	27	27
Consultancy	31	36	67	45
Training/Conferences/Events	47	40	27	64
Networks	26	16	27	27
Commercial application/Exploitation	8	40	20	9
Strategic Partnerships/Ventures	11	12	0	9
Other	18	12	13	37
Number of respondents	*51*	*25*	*15*	*11*

Source: PACEC Survey (q16a)

2.11.6 The aims of comparison group firms in becoming involved with the support organisations are similar to those of RTO users:

- Improving technical skills
- Keeping abreast of technology developments

2.11.7 Networking and keeping abreast of industry developments are less important aims for those using universities and other alternative sources of support.

2.11.8 The impact of the alternative sources of support on the skills, capabilities and activities of firms has been more moderate than that of RTOs on their users. For example, in contrast to Table 2.31 above, the impact of involvement in a collaborative research project on the various capabilities was moderate in around 40% of cases and substantial in around 10%. Similarly the impact of involvement in training / conferences or events was found to be moderate in 50-60% of cases and substantial in around 10%. An exception to this general trend has been the impact of involvement in collaborative research projects for the introduction of new products / services, perhaps because this is a more proactive activity for comparison group firms.

2.11.9 The impact of the alternative sources of support on business performance appears to be very significant with a third of firms considering turnover and employment had increased as a result of involvement in the project/service however with low response rates the difference between the comparison group firms and the RTO user firms may not be significant.

2.11.10 More than half of the comparison group of firms were aware of an RTO for their sector but there is very stark difference in this respect between medium and large firms (70%) and small firms (20%). Forty percent of the comparison group firms felt the RTOs are significant in promoting innovation within the sector but very many did not know or felt unable to comment. RTOs were felt to offer a focal point for support and played a central role within sectors / industries. They also offer opportunities for networking and collaborative research.

2.11.11 Just under 40% of firms contacted through the matching sample answered only a small subset of questions targeted at those who do not use external sources of support. Amongst this group, over a third are a member of a trade association such as the Federation of Bakers or the British Cement Association.

2.11.12 Forty percent of the matching sample are aware of an organisation offering some of the services RTOs offer, eg consultancy, training and conferences, and collaborative research projects, and most are members of such a body. These organisations included, trade associations, universities and some RTOs.

2.11.13 Firms who are aware of support organisations but are not a member use such services on an ad hoc basis. Amongst those who are not aware of an organisation for their sector half think it would be a good idea and expect they would use such an organisation occasionally and support research.

2.12 Universities Views on RTOs

2.12.1 Most universities have working relationships with RTOs and some have strong relationships and are familiar with their contributions to research funding and partner working. Recognition and understanding of the term RTO was not universal, particularly in University Industrial Liaison offices however relationships between the University and RTO are often at the level of an individual academic or department.

2.12.2 The importance of a university's relationship with other research companies and R&D intensive companies was recognised to be more significant than with RTOs, offering greater opportunities for funding, collaborative relationships and income generation. These range from international companies such as Nestle, Procter and Gamble, Welcome Trust, BAE Systems and Rolls Royce as well as local SMEs at on-campus innovation centres (including related spin out companies) and laboratories. However the direction for research relationships with RTOs was said to be towards a more collaborative, mutually beneficial one.

2.12.3 Relationships with RTOs are often departmental or held at an individual academic level. Involvement is very often through a Faraday Partnership. Collaboration in a project is the main form a relationship with an RTO and is becoming more important. Some departments are closer to applied research than others and these departments usually have closer relationships with industry and RTOs. Such departments include: Engineering (Chemical, Civil, Mechanical and Electrical), Applied Mathematics, Computer Science, Medicine and the Built Environment. Likewise five star (excellent) research departments were more fully involved in relationships with RTOs.

2.12.4 Other involvement includes:

- Academics representation on advisory boards
- RTOs for sponsorship for MSc, PhD research programmes, and post-doctoral research projects.

2.12.5 The benefits to the university are as follows:

- RTOs sit between industry and research and provide universities with an insight into 'real world and current problems for industry.
- RTOs provided a positive contribution for research funding. Funding allows academics to work at the cutting edge of their discipline and potentially create revenue for the university, partners and industry through commercialisation and exploitation.
- RTO may offer post-graduate sponsorship, case studies and work experience/ placements to postgraduate students.
- Faraday Partnerships are perceived to have benefited greatly from RTO involvement.

On the other hand RTOs are seen to compete for research funding with universities.

2.12.6 RTOs are recognised as playing an important role in the innovation process. RTOs link university and industry together - they facilitate the spread of new technology to a broader business environment. RTOs comprise an important part in the matrix of technology transfer and at their best RTOs were seen as a powerful mechanism in the innovation process, providing incentives and enabling universities to work closely with business. For others, whilst RTOs are a partner their involvement is less significant than other research companies.

2.13 Summary Overview

2.13.1 RTOs play a significant role as intermediary organisations in the process of technology transfer. The majority of them have membership schemes which are representative of the sectors or technologies they serve. Where it is not representative this is typically as a result of relatively few smaller enterprises having membership. Around half is sector specific and a half is focused on specific technologies.

2.13.2 RTO income comes principally from consulting, testing and prototyping services which are important mechanisms of knowledge transfer and intermediation. ERTOs are relatively more likely to derive income from private sector funded research and product/process exploitation.

2.13.3 RTOs are extensively involved in collaborative activities, very frequently in a lead capacity. In a high proportion of cases, partners are inventors indicating a significant role for RTOs as intermediaries in this important area.

2.13.4 There is evidence that RTO activity generates spillovers beyond their immediate members and RTO industry users value their intermediation role in terms of costs (relative to private sector consultancies) and in terms of commercial understanding and timescales compared to universities.

3 The UK Tax System, RTOs and Knowledge Transfer

3.1.1 In this chapter we discuss aspects of the tax system that are relevant to the activities of RTOs and knowledge transfer activity generally.

3.1.2 There are three key aspects of the tax system that affect incentives to undertake activities that may be associated with knowledge creation and knowledge transfer. These are: (1) exemption from corporation tax under Section 508; (2) the general tax system, in particular statutory corporate income tax rates and capital allowances; (3) R&D tax reliefs. We discuss each in turn.

3.2 Exemption from corporation tax under Section 508 (ERTO status)

3.2.1 We first discuss the system of exemption from corporation tax under Section 508, and present evidence on RTOs' perceptions of the current regime.

3.2.2 S.508 status grants companies the non-tax-paying status of a charity. Tax exempt status is retrospectively determined by the DTI on a discretionary basis. The legislation requires that S.508 bodies must not distribute their profits, and must exclusively undertake "scientific research" that may support an "extension of trade". There are also restrictions on contract research that gives any firm an exclusive advantage. There are several aspects of the S.508 rules that merit particular discussion.

Definitions of "scientific research" and "extension of trade"

3.2.3 Scientific research is defined in the legislation as "any activities in the fields of natural or applied science for the extension of knowledge". Under the new guidelines which came into force in 1998 this is now interpreted fairly strictly, with the key test being one of innovation. Thus activities are likely to involve scientific research if they consist of the application of *new* scientific principles in an existing area of research, or the application of existing scientific principles in a *new* area of research. Many activities that might come under the heading of "knowledge transfer" are thus not included, for example "passing on the research of others" is explicitly excluded in the guidelines. However the guidelines do state that "an activity which added value by giving an insight into how existing knowledge could be applied in a new area" could qualify as scientific research.

3.2.4 The requirement that research must have as its aim an "extension of trade" is taken to rule out "basic research which has no immediately identifiable practical application". An "extension of trade" is also taken to require that results must be "made publicly available or at least available freely to the members of the ERTO as a whole". Confidential research which is intended to provide an exclusive competitive advantage is highly unlikely to qualify. Private contract research may qualify if the results are likely to become available to others "within a moderate period".

Wholly-owned subsidiaries of S.508 organisations

3.2.5 The DTI told us that when the revised Guidance Notes were introduced in 1998 the Department recognised that some ERTOs would have difficulty meeting the requirements and that some would need to restructure to sustain approval. Annex B to the Guidance Notes, modelled on charity requirements, sets out one way in which ERTOs could adjust to meet the revised rules by establishing wholly owned subsidiaries to carry out non-qualifying activities. Annex B requires that an ERTO should only invest in a subsidiary after evaluation of all other investment options (taking into account dividend yield, capital growth and liquidity) has shown that the investment is likely to produce at least comparable returns; and to maintain the investment only if it delivers expected returns in practice.

3.2.6 The DTI had encountered difficulties in administering the "reasonable return" condition. For example, at the moment, due to pension fund deficits some organisations weren't paying anything to the S.508 parent. The extent to which this condition is enforced will have implications for how restrictive the S.508 regime is in practice.

3.2.7 Wholly-owned subsidiaries are able to undertake activities including single-client research and applying for government grants (e.g. SMART). They are also able to receive Research Council funding. Most ERTOs find this an important aspect of the S.508 regime.

Contrast of S.508 status with charitable status

3.2.8 The tax treatment of ERTOs is similar to that of a charity. However, an ERTO's assets are not ring-fenced for scientific research in the way that a registered charity's assets are circumscribed and assigned exclusively for charitable purposes should charitable status ever be lost. In administering the provision the DTI is concerned to protect against the possibility of the loss of scientific research assets built up on the back of tax exemption over many years. There has been at least one recent case where the DTI has been especially concerned.

3.2.9 Charitable status has the advantage over S.508 because there is less uncertainty over yearly renewal of SRA status and there is more flexibility over permissible activities. At least two former section 508 bodies have recently sought and secured registered charity status. While this means that the bodies concerned will now be subject to full charity regulation, it also provides a more certain tax environment and allows them to undertake a wider range of activities provided the public benefit test is met. In the context of the current review of charity law, and in particular the proposal to set down a more broadly based list of charitable purposes, the DTI has suggested that one option for consideration might be to accommodate more specifically scientific activities carried out for public benefit.

3.2.10 The Inland Revenue questioned whether the Charity Commission would be ideally suited to making decisions in this area.

3.2.11 AIRTO said that their members preferred S.508 to charitable status because members did not want to lose the 'SRA' label (although it was noted that there might be dissenting views within AIRTO on this point).

Evidence of RTOs' views on charitable status

3.2.12 In the survey of RTOs discussed in the previous chapter, one ERTO thought it would be eligible for charitable status, one thought it would not be, and the rest did not know. All NERTOs thought they would not be eligible.

Table 3.1 Do you think you would be eligible for charitable status?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Yes	7	13	0
No	53	**13**	**100**
Don't know	10	**75**	0
Number of respondents	*15*	*8*	*7*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q57a)

3.2.13 Several RTOs, including two ERTOs, said charitable status would not fit with their corporate culture. Other cited drawbacks of having charitable status included further costly restructuring and being subject to the control of the Charity Commission.

Compliance and administrative costs of the S.508 regime

3.2.14 According to the DTI, in 1996 the total size of relief under S.508 was about £7-8m. Following the introduction of the new DTI guidelines it is much less, probably more like £2-3m. The Inland Revenue estimate that the total cost of the relief may be even less than this. They have records for 11 ERTOs in 2001, for which the total cost was £417,022. They have the names of a further 17 organisations that may be or have been ERTOs, but for which they have no tax records for 2001.

3.2.15 Currently, following the introduction of the new guidelines in 1998, the DTI told us that there are at present 15 bodies which have secured or are actively securing S508 approval. It should be noted that for the purposes of the PACEC survey of RTOs we have only been able to identify 10 ERTOs, and the Inland Revenue were only able to find records for 11 ERTOs for the most recent available tax year. However, several bodies who dropped out after 1998 in order to restructure are expected to come back in. Currently the administrative cost involves about 1.5 full time DTI employees and perhaps 10% of the time of one Inland Revenue tax inspector. DTI considered the costs were of the order of £10,000 per successful applicant.

3.2.16 AIRTO estimated the initial cost for applicants to obtain S.508 status as £60,000, with £15,000 per annum continuing costs of compliance. The main cost was simply man-

hours of complying with requirements. The average surplus of an AIRTO member is £650,000 so often it is not worth the trouble of obtaining SRA status.

3.2.17 In the interviews with RTOs discussed in Section 2, the cost of complying with S.508 was estimated at some £20,000 - £35,000 for restructuring at the start of the process (i.e. post 1998) with annual application and project audit costs of £20,000 - £45,000 depending on the RTO (with a mean of £28k). The estimated tax benefits depended on the profits made and ranged from zero up to £300k per annum.

Interactions of S.508 with other policies

3.2.18 S.508 rules prohibit ERTOs from making grant applications with industry partners which would give an exclusive advantage, although ERTOs (and their wholly-owned subsidiaries) can apply for Research Council funding. However, it seems that this does not apply to wholly-owned subsidiaries of NERTOs. As shown in the previous chapter, most ERTOs are involved with government-sponsored technology transfer programmes such as Faraday partnerships and LINK. AIRTO told us that ERTOs get more money collectively from sources such as DEFRA and the EU than from DTI support schemes.

3.2.19 S.508 interacts with the R&D tax credits in several important ways. These are discussed below in the section on R&D tax credits.

Other issues raised in interviews about S.508 status

3.2.20 In discussion with DTI the key issues and perceived shortcomings of S.508 status were as follows:

3.2.21 Perceived shortcomings of the legislation stem from the fact that it was written in the 1950s to deal with industry-funded bodies. The current interpretation is as flexible as possible within the law. Even so, it would appear that some valuable scientific organisations are unable to benefit. The DTI's view is that the legislation was moulded to accommodate trade related scientific research associations as they were in 1950 when the law was first introduced. Changes in the structures and activities of those bodies since then mean that many are now not well placed to secure section S.508 status

3.2.22 The 1998 DTI guidelines stipulate that ERTOs must undertake *exclusively* scientific research. This excludes many bodies who undertake activities such as technology transfer and technology consulting, and there are thus far fewer bodies with S.508 status than there were before 1998. In fact, even the broader definition of R&D used for the R&D tax credits would not include many of these bodies because of this exclusivity rule. The results of the survey of RTOs reported in the next chapter show that R&D accounts for on average only 26% of ERTOs' activity and only 17% of NERTOs' activity, with a maximum of 50%.

3.2.23 The S.508 guidelines allow “ancillary expenditure” on activities that support the main objective of undertaking scientific research, although this cannot be a very large part of total expenditure. The example offered in the Guidance Notes is where an ERTO runs educational open-days for schools.

3.2.24 Another key limitation of current legislation is that it stipulates that scientific activity must support "an extension of any class or classes of trade”. This means that pure blue-skies research which has no immediately identifiable practical application will not qualify nor will research which, even though it has a public benefit, will not be capable of extending trade.

3.2.25 ERTO status is renewed retrospectively every year. This introduces a significant amount of uncertainty for firms.

The RTOs’ views on the benefits and disadvantages of Section 508

3.2.26 All of the ERTOs and half of the NERTOs reported that they had been affected by changes to section 508 mainly because of the need to restructure and comply with the S.508 requirements.

3.2.27 Table 3.2 shows RTOs’ responses on the benefits of having ERTO status. We should note that only 6 out of the 10 ERTOs answered this question, and only 6 NERTOs. In addition to exemption from corporation tax, the main benefits of S.508 status identified in interviews by those who are eligible included:

- Ability to fund / raise money for own research / R&D
- Status/image/branding and conveys quality of research
- Allows access to research council funds
- Capacity for scientific research

Table 3.2 What are the benefits of having S.508 status?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Corporation Tax advantage	92	83	100
Able to fund own R&D	25	33	17
Raise money for research	25	33	17
Conveys quality of research	25	**50**	0
Research Councils	25	**50**	0
Provides a focus	17	33	0
Capacity for scientific research	17	33	0
Not for profit status	8	0	17
Status/image/branding	8	17	0
Capital gains tax advantage	8	0	17
Other	8	0	17
Number of respondents	*12*	*6*	*6*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q53a)

3.2.28 Table 3.3 shows RTOs' responses on the disadvantages of having ERTO status. We should note here that only 5 out of the 10 ERTOs answered this question, and only 4 NERTOs. The main disadvantages of S.508 reported in interviews included:

- the cost and complexity of the "artificial" 'parent and subsidiary structure'
- the administrative burden of the yearly application
- the uncertainty of the retrospective application
- uncertainty of the changing rules
- not seen as commercial

3.2.29 These were also amongst the reasons for formerly S.508 organisations ceasing to apply since 1998, along with:

- a recognition that activities would no longer qualify
- the need to refocus the organisation to more commercial aims
- transition to management buy out / employee benefit trust companies
- a perception that tax exemption under section 508 would be fully phased out in the medium term

Table 3.3 What are the disadvantages of having S.508 status?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Cost, complexity	89	100	75
Uncertainty of retrospective application	67	**100**	25
Artificial structure to company	56	60	50
Uncertainty of changing rules	33	60	0
Not seen as commercial	33	40	25
Considered 508 would be removed in medium term	22	20	25
Number of respondents	*9*	*5*	*4*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q54a)

3.2.30 For the firms who had previously had S.508 status it was not renewed primarily because of the costs, together with uncertainty over retrospective applications (to the DTI), and because it would mean an artificial structure to the company.

3.2.31 Just over half of the Non-S.508 organisations have previously claimed tax exemption. A significant minority of these retain the structure and profile of activities that would allow them to claim, and mostly don't apply for exemption at the moment because of a recent history of forecast losses.

Final comments on tax exemption under S.508

3.2.32 It is important to note that ERTOs are not constrained in the activities they can carry out, since any activities that do not qualify under the S.508 requirements can be carried out by a wholly-owned subsidiary. The only condition is that the S.508 parent must obtain a reasonable rate of return from its subsidiary. However, the tax exemption only benefits the S.508 parent that carries out the qualifying activities. Surpluses generated by subsidiaries can only be exempt from corporation tax if they are gift-aided to the parent. Otherwise they are subject to corporation tax in the normal way.

3.2.33 A key feature of the current system is that the number of ERTOs has dropped significantly in recent years following the introduction of the new DTI guidelines in 1998. A number of NERTOs that were formally ERTOs may not find it worthwhile to obtain ERTO status, even if they undertake activities that would qualify. One reason for this could be the introduction of the R&D tax credits, which are discussed below. In addition, as mentioned in paragraph 3.2.31 above, several NERTOs have a recent history of and forecast losses, which means that ERTO status would not benefit them from a tax point of view (there may be benefits associated with Research Council funding etc). As discussed further below, loss-making NERTOs could still benefit from the SME R&D tax credit.

3.3 General tax system - corporation income taxes and capital allowances

3.3.1 Statutory rates of corporation tax vary with the level of pre-tax profits. Table 3.3 shows how the marginal and average corporation tax rates vary with pre-tax profits. This variation will introduce additional complexity to the tax-modelling as described in the next chapter.

Table 3.4 Statutory corporation tax rates

Profits (£ p.a.)	Marginal tax rate (%)	Average tax rate (%)
< 10,000	0	0
10,001 – 50,000	23.75	10 – 19
50,001 – 300,000	19	19
300,001 – 1,500,000	32.75	19 – 30
> 1,500,000	30	30

Source: IFS and Tolleys

3.3.2 The tax system distinguishes three types of expenditure for the purposes of capital allowances.[6] All current expenditure can be deducted from taxable profits at a rate of 100% in the year that it is incurred. As discussed below, the rate is higher than 100% for current expenditure on R&D. Current expenditure includes wages and salaries, and materials and intermediate inputs. Evidence suggests that together these make up about 90% of a typical R&D project.

3.3.3 Expenditure on Plant and Machinery can be deducted from taxable profits on a 25% declining balance basis. Thus 25% of expenditure can be deducted in the year it is incurred, 25% of the remaining balance in the next year and so on. For SMEs there is an enhanced rate of 40% in the first year.

3.3.4 Expenditure on Buildings and Land can be deducted at a rate of 4% of the initial expenditure each year.

3.3.5 The exception to these capital allowances is that under the R&D Allowance, 100% of capital expenditure on R&D can be deducted from taxable profits in the year it is incurred. This is considerably more generous than the normal capital allowances.

3.4 R&D tax relief

3.4.1 Enhanced tax relief for R&D is one of the most important aspects of the tax system in relation to innovation and knowledge transfer. There are two forms of tax relief for R&D available in the UK, one introduced in 2000 for SMEs, and another introduced in

[6] A special allowances for investment in ICT is currently available to SMEs. This is not modeled here.

2002 for large firms. Both operates as an extra deduction on current expenditure on R&D.

3.4.2 Under the SME relief a firm can deduct 150% of qualifying expenditure from its taxable profits. The benefit of the relief to the firm thus depends on the tax rate it pays. There is also a repayable aspect, such that a SME that makes a "surrenderable loss" during the period (i.e. makes negative profits) is able to surrender this to the Inland Revenue in exchange for a payment of 16% of the qualifying expenditure. This amounts to 24% of its current expenditure on R&D, since qualifying expenditure is equal to 150% of eligible R&D expenditure (or total trading losses if that is smaller). Projects that receive funding from government under another scheme are not eligible for the relief. There are further complexities to this repayable credit which we consider below.

3.4.3 The large firm relief allows firms to deduct 125% of qualifying expenditure.

3.4.4 A key aspect of the system for our purposes is the impact of the tax system on R&D sub-contracted by one firm to another. Table 3.5 shows the system of R&D tax relief for different combinations of principal and sub-contractor. Apart from the rate, the key difference between the SME tax relief and the Large Firms' relief is that with the former the relief is claimed by the principal, while in the latter it is claimed by the sub-contractor. The exception to this is that a large firm can claim for R&D that it sub-contracts to a "qualifying organisation", as defined under the terms of the legislation. These are generally tax-exempt organisations, including ERTOs, who would not be able to claim the relief themselves. Another key aspect of the system is that when a SME performs R&D contracted to it by a large firm or a non-profit organisation it claims relief under the terms of the large firms' relief.

3.4.5 The SME scheme also differs from the large firms scheme in that the rules for the SME scheme depend on whether the (SME) principal and the sub-contractor are "connected". If they are connected then the principal can claim R&D tax relief on the lower of the payment it makes to the sub-contractor or the amount the sub-contractor actually spends on qualifying R&D expenditure. If they are not connected then the principal can claim R&D tax relief on 65% of the payment it makes to the sub-contractor, reflecting the fact that the payment will cover an element of profit for the sub-contractor as well as some non-qualifying expenditure. This acts to reduce the generosity of R&D tax relief in this case. However, the principal and sub-contractor may make a joint election to be treated as if they were connected at any time within two years of the end of the principal's accounting period in which the payment is made. For this reason we assume for the purposes of the tax modelling that the full relief applies to all sub-contracted R&D in the same way to own R&D. In the case where the principal and sub-contractor are connected or choose to treated as if they were connected this will be a very close approximation.

3.4.6 In Table 3.5 the "non-profit" category includes ERTOs exempt from tax under Section 508. However, in most cases an ERTO would be excluded from carrying out private contract R&D as this would fall outside the dissemination requirements in the relevant

legislation (of course they could do it through a wholly-owned subsidiary). The exception to this is if the contract explicitly states that the results of the research will be widely disseminated. Situations where an ERTO does contract R&D through a subsidiary will be discussed below.

Table 3.5 Rates of R&D tax relief for different combinations of principal and sub-contractor

	Sub-contractor: Self	SME	Large firm	Non-profit
Principal:				
SME*	50%	[50%]	[50%]	[50%]
Large firm	25%	25%	25%	[25%**]
Non-profit	0%	25%	25%	0%

Notes: numbers in [ ] indicate that the principal claims the relief, otherwise the sub-contractor claims.
* The SME claiming the credit must retain at least some of the IP created by the R&D. In addition, no tax relief is available for any project that has received funding that is a notified "state aid", and only the unsubsidised part is eligible if the funding is not a state aid.
** Under certain circumstances this includes payments that fall outside of a contractual framework, for example donations to an ERTO or university department. The R&D performed must not be contracted out by anyone else, and the firm claiming the tax relief must not be connected with anyone receiving the payments for R&D. See discussion in the main text.

Contributions towards independent R&D

3.4.7 There is a potentially important difference between the SME R&D tax relief and the large firms relief when it comes to contributions to independent R&D carried out by "qualifying bodies". These are contributions that fall outside of a contractual framework. These kinds of payments do not qualify under the SME tax relief but do qualify under the large firms scheme as long as the R&D is relevant to the firm and the firm is not "connected" to anyone receiving the payments.[7] In addition there is no provision for SMEs to claim relief under the large firms rules in this case. This contrasts for example with R&D subcontracted by a large firm to a SME, in which case there is a specific statutory provision allowing the SME to claim under the large firm rules.

3.4.8 It should also be noted that the SME R&D tax credit requires the SME claiming the credit to retain at least some of the Intellectual Property (IP) produced by the R&D. This is not true of the (less generous) large firms credit. The Inland Revenue guidelines state that this IP can take the form of "know-how", and that the IP can be jointly held, so it is not clear whether this condition imposes very restrictive conditions in practice. For example, collaborative R&D where the resulting IP was jointly held would be eligible for tax relief. However, a strict interpretation could have further

[7] Note that any change to the SME scheme to include contributions to independent R&D would interact with the SME rules on sub-contracting. If a SME chose to make independent contributions to an organisation on which it claimed R&D tax relief, it could then only claim for 65% of any R&D sub-contracted to the same organisation, since they could not be connected for the contributions to eligible for the relief.

negative consequences for a SME's incentives to pay towards some forms of collaborative R&D where the results were widely disseminated.

The definition of R&D for tax purposes

3.4.9 The current definition of R&D for tax purposes distinguishes R&D from other activities by the "presence or absence of an appreciable element of innovation". As well as this focus on innovation, the Inland Revenue guidelines are similar to those for the interpretation of "scientific research" in that they refer to the application of new principles in an existing area of investigation and the application of existing principles in a new area. R&D does not include "activities based upon the use of well-established products or processes, which may be new to the user but do not represent any departure from common knowledge or practice for the industry sector concerned".

3.4.10 In his December 2003 Pre-Budget Report the Chancellor announced proposed changes to the definition of R&D for tax purposes. These are in response to the consultative document issued in July 2003 and their main aim is to make the definition more predictable and easier for firms to interpret. The main proposed change is to replace the current requirements for 'novelty' and 'innovation' with the need to show an "advance in science or technology" through the resolution of "scientific or technological uncertainty". As before this includes the "adaptation of knowledge or capability from another field of science or technology in order to make such an advance". The Government's response to the consultation considers the case for an extension of the R&D tax credit to all commercial development, but rejects this in favour of continuing to focus support on the riskiest part of the development cycle, i.e. where the technological uncertainties remain.

3.4.11 The definition of R&D for tax purposes is generally broader than that of "scientific research" at both ends of the spectrum from basic research to experimental development. Basic research is included in R&D even if it has no clearly identifiable commercial application, and experimental development and testing of a new product is included as long as all scientific or technological uncertainty has not already been resolved. Thus standard testing for quality control or pre-production planning does not count as R&D. The Inland Revenue used the example of a 3-D software engine for computer graphics to describe the differences between "scientific research", R&D and commercial development. The initial development of the software engine was judged to be R&D for tax purposes, but the subsequent integration of the engine into various computer games was not. Neither the initial development of the software engine nor the subsequent commercial development would have counted as scientific research.

Interactions between S.508 and the R&D tax credits

3.4.12 R&D tax relief is not beneficial to ERTOs parent organisations since they are exempt from corporation tax. Their subsidiaries can claim R&D tax relief. However, this does not affect the overall post-tax price of the R&D from the parent ERTO's point of view

if the subsidiary gift-aids its profits to the parent ERTO. In this case the only effect of the tax relief is to allow the subsidiary to accumulate more funds than it otherwise would. If the subsidiary does not gift-aid all of its profits to the parent ERTO then the relief changes the tax price of the R&D in the normal way.

An example

3.4.13 An example helps to illustrate this point. Consider as a base case a subsidiary that makes a surplus of £10m and gift-aids all of it to the ERTO parent. The subsidiary is a SME and spends £1m of current expenditure on R&D, but there is no R&D tax relief. No corporation tax is paid, and the £10m surplus goes towards scientific research carried out by the parent. Suppose now that R&D tax relief is introduced so that the subsidiary's £1m of current R&D expenditure is eligible for the SME R&D tax relief. The R&D tax relief allows the subsidiary to deduct an extra £500,000 from its taxable profits, leaving a surplus of £9.5m instead of £10m. As before, this surplus is gift aided to the ERTO parent, and, as before, no corporation tax is paid. The tax price of the R&D has not changed because the same tax is paid as before on the same activity (i.e. none), and the only effect of the R&D tax relief is to allow the subsidiary to accumulate an extra £500,000 free of tax – money which before went towards scientific research carried out by the ERTO parent.

3.4.14 Now consider a second base case. A subsidiary makes a surplus of £20m, £10m of which it gift-aids to the ERTO parent as a "reasonable return". It pays corporation tax at 30% on the remaining £10m, so £3m in corporation tax. Suppose now that R&D tax relief is available on the subsidiary's £1m current expenditure on R&D, allowing it as above to deduct an extra £500,000 from its taxable profits, leaving a surplus of £19.5m instead of £20m. As before, £10m is gift-aided to the parent, leaving £9.5m of taxable profits instead of £10m. Thus it pays 30% of £9.5m in corporation tax, which is only £2.85m. Thus the tax price of the R&D is changed in the usual way.

Interactions between S.508 and the R&D tax credits when R&D is sub-contracted

3.4.15 As shown in Table 3.5, SMEs can claim R&D tax relief for R&D that they sub-contract to an ERTO or its subsidiary, as long as the IP conditions in the SME scheme are satisfied. However, ERTOs are generally not allowed to undertake private contract R&D, unless there are specific provisions governing the dissemination of results. Their subsidiaries are allowed to undertake contract R&D. As discussed above, SMEs are not able to claim relief on contributions to independent R&D, or any non-contractual payments towards collaborative R&D performed by an ERTO.

3.4.16 ERTOs are "qualifying bodies" for the purposes of the large firms R&D tax credit, allowing large firms to claim relief on R&D sub-contracted to an ERTO. However, ERTOs are generally not permitted to undertake this kind of private contract R&D. Subsidiaries are allowed to undertake contract R&D, but are not "qualifying bodies", so they can claim the relief rather than the commissioning large firm. This means that tax relief does not change the tax price of R&D sub-contracted by a large firm to the

subsidiary of an ERTO, unless the subsidiary does not gift-aid all of its profits to the parent ERTO. The potential impact on these arrangements of applying the tax definition of R&D to the rules for ERTO status is discussed below. The main point is that the most important restriction on large firms' ability to claim relief on R&D sub-contracted to ERTOs is probably not the narrow "scientific research" definition of eligible activities, but the conditions on dissemination of results.

3.4.17 The large firms relief allows large firms to claim tax relief on payments for independent R&D that fall outside of a contractual framework. The example given in the IR guidelines is contributions to a university department, but this category is likely to include some membership fees paid to ERTOs, as well as some non-contractual payments for collaborative R&D performed by ERTOs. To be eligible for relief, the R&D performed must be "relevant" and not contracted out by someone else. In addition, the firm claiming the relief must not be connected with anyone receiving the payments for R&D.

3.4.18 Universities also come under the "qualifying bodies" category for contract research under the large firms tax credit. The Inland Revenue pointed out that, similarly to ERTOs, universities should not technically perform this kind of contract R&D other than through a subsidiary. However, universities normally charge for contract R&D at a rate that is not profit generating (i.e. they usually do contract R&D to fill empty lab time, cover fixed costs etc). In the absence of potentially taxable profits, the IR does not normally pursue the issue. This is in contrast to the strict enforcement of the Section 508 conditions by the DTI. The difference stems from the DTI being concerned with wider regulation of S.508 bodies while the IR is only concerned with the tax liabilities of universities.

3.4.19 AIRTO claimed that the Inland Revenue is not consistent in its application of the R&D tax reliefs, and that AIRTO members have found it hard to get the relief for contract research. However, no examples were provided to illustrate this.

4 Modelling the Impact of the Tax System on RTO Incentives

4.1 Introduction

4.1.1 In this chapter we describe the activities that RTOs undertake, particularly in relation to the way in which these activities will be treated by the tax system. Broadly there are two groups of activities - those that qualify for the R&D tax reliefs and those that do not. In addition, the organisational form of the body financing and the body undertaking the R&D matter.

4.1.2 In considering how taxation will affect behaviour we need to ask: (i) how taxation will change the cost (price) of undertaking the activity, and (ii) how individuals will respond to a change in the cost. The bulk of our analysis is on the first question. In section 4.4 we describe how we do this and in sections 4.6-4.8 we present the results with respect to R&D activities. In section 4.9 we discuss the results from our survey of RTOs asking how they perceive the tax system as affecting their R&D activities. In section 4.10 we discuss the impact of tax on non-R&D activities, which is minimal.

4.1.3 A summary and our conclusions from this chapter are presented in section 5.

4.2 Activities of RTOs

4.2.1 In this section we present information on the activities of RTOs taken from the survey of RTOs and of firms using RTOs that are relevant to the tax-modelling. Key factors include: size (especially SME status); profitability; sources of income, including the nature of contractual relationships; and types of activity undertaken, in particular the amount of R&D. We first discuss evidence on the relevant characteristics of RTOs themselves and then evidence on the relevant characteristics of firms that currently use RTOs.

Characteristics of RTOs

4.2.2 As shown in Chapter 2, about two-thirds of ERTOs and NERTOs are SMEs under the employment and turnover definitions, and the rest are large firms.

4.2.3 As shown in Tables 4.1 and 4.2, of those who answered the question, most NERTOs and both ERTOs have profits/surpluses well in excess of £1.5m, meaning that the marginal corporation tax rate that would face if they were NERTOs is 30%. Of those answering, five NERTOs made losses in the current year and six in the previous year, and neither of the two ERTOs did. However, there are clearly some concerns over the representativeness of these results given the low number of responses.

Table 4.1 Can you say what your group profit / surpluses has been in the most recent operating year?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Loss	31	0	38
Under £1M	13	0	15
£1M to £10M	0	0	0
£10M to £25M	0	0	0
£25M to £50M	6	0	8
£250M to £500M	19	0	23
£500M to £1B	6	50	0
Over £1B	19	50	8
Number of respondents	*15*	*2*	*13*

Source: PACEC Survey (q109abnd)

Table 4.2 Can you say what your group profit / surpluses has been in the most recent operating year bar one?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Loss	46	0	55
Under £1M	0	0	0
£1M to £10M	0	0	0
£10M to £25M	8	0	9
£250M to £500M	15	0	18
£500M to £1B	23	100	9
Over £1B	8	0	9
Number of respondents	*13*	*2*	*11*

Source: PACEC Survey (q109bbnd)

4.2.4 Table 4.3 shows the main sources of income in the most recent year for the RTOs surveyed. This includes income of subsidiaries. Membership fees make up only about 6% of income for both ERTOs and NERTOs. Collaborative research with private sector funds makes up a further 7.3% of ERTOs income on average, and private contract research a further 15.2%. Research of all kinds makes up an average of 33% of ERTOs' income, and 29% of NERTOs' income. Research activities are those that are most likely to create spillover benefits, and especially those of a collaborative nature. Activities such as consultancy and testing are less likely to provide spillover benefits to other firms. This is important when we consider what types of activity should be targeted by the tax system.

4.2.5 Looking at Table 4.3 we see that if we add together Collaborative research from public and private sector funds these make up 14.6% for ERTOs and 14.4% for NERTOs. So in total ERTOs and NERTOs do the same amount of collaborative

research, but NERTOs use more public sector grants. ERTOs use more private sector funding, but get public sector support through their tax exempt status.

4.2.6 In addition, ERTOs and NERTOs do similar amount of contract research, but for ERTOs more is private sector funded. This raises the question of whether tax exempt status has an appreciable impact on the activities of ERTOs, or whether it leads to similar activities being undertaken with similar levels of government support, but using a different structure. The data available to us is not sufficient to answer this question.

Table 4.3 If we take the most recent year can you say what the sources of income have been?

	Average (mean) of all respondents. (by S508 Status)		
	Total	ERTO	NERTO
Consultancy	21.6	14.7	26.2
providing facilities / prototyping / testing	19.1	14.0	22.6
Collaborative research (with public sector funds)	9.3	**7.3**	10.7
Collaborative research (with private sector funds)	5.1	**7.3**	3.7
Contract research(private sector)	8.4	**15.2**	3.9
Contract research(public sector)	8.3	**4.1**	11.1
Exploitation of products / processes	6.8	16.1	0.7
Membership fees	6.2	6.4	6.1
Training	3.1	4.9	1.9
Publications	2.4	0.3	3.7
Conferences / Networks	2.3	1.1	3.1
Other	7.5	8.7	6.7
Number of respondents	*25*	*10*	*15*

Source: PACEC Survey (q49)

4.2.7 80% of ERTOs do private contract research. As discussed in chapter 3, this is done through subsidiaries, apart from one case.[8]

4.2.8 Table 4.4 shows that all of the surveyed ERTOs undertake at least some scientific research which is not funded by public sector grants and is not privately contracted. This is mainly collaborative research done with or for members, but also within ERTOs' own research and development programme. Less than half of the NERTOs engage in this activity. The NERTOs tend to concentrate on applied or commercial research such as consumer research and market trends.

[8] The exception is the Aircraft Research Association where special factors arise.

Table 4.4 Do you undertake any scientific research which is not funded by public sector grants (and is not privately contracted)?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Yes	64	**100**	44
No	36	**0**	56
Number of respondents	*25*	*9*	*16*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q89a)

4.2.9 Table 4.5 shows the proportion of expenditure that responding RTOs reported was on R&D. While ERTOs do more over most of the distribution (except at the maximum) the proportions are not statistically significantly different.

Table 4.5 How much of your current expenditure would you say is on R&D?

	Statistics of all respondents. (by S508 Status)		
	Total	ERTO	NERTO
Median	17.5	22	10.5
Mean	18.7	23.3	16.1
Min	1.5	2.0	1.5
Max	50	40	50
Number of respondents	*22*	*8*	*14*

Source: PACEC Survey (Q67b)

4.2.10 Of the 11 RTOs who answered the question about how much of this R&D expenditure was eligible for R&D tax reliefs, the average was between 40% and 50% of total R&D expenditure, with little difference between ERTOs and NERTOs. For two ERTOs (half of the four who answered) and two NERTOs (half of the four who answered) this included expenditure sub-contracted to them by a large firm. Again we might be concerned about the representativeness of these results given the low number of responses. There was no indication of why RTOs thought that most of their R&D expenditure would not be eligible for R&D tax relief.

4.2.11 As shown in Table 4.6, just over half of the RTOs have used R&D tax credits, these are mainly NERTOs, but 4 of the ERTOs have also used them through their subsidiary companies.

Table 4.6 Have you claimed R&D tax credits?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Yes	52	40	59
No	48	60	41
Number of respondents	*27*	*10*	*17*

Source: PACEC Survey (q62a)

Relevant characteristics of firms currently using RTOs

4.2.12 Table 4.7 shows that a majority of responding RTOs (both ERTOs and NERTOs) report that their UK membership consists mainly of small or medium sized firms (SMEs). This is not reflected in the separate survey of firms using RTOs, where only 20% (17 firms) are SMEs. As we discussed in chapter 2, the survey of firms using RTOs is not representative of RTOs' overall membership, and this should be borne in mind when interpreting the discussion which follows.

Table 4.7 Does your UK membership consist mainly of small, medium or large firms?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Small	17	29	0
Medium	42	29	60
Large	42	43	40
Number of respondents	*12*	*7*	*5*

Source: PACEC Survey (q113)

4.2.13 Table 4.8 shows how the surveyed firms have been involved with RTOs. The most common forms of involvement are collaborative research projects and membership. Next most common are consultancy and training/conferences/events.

Table 4.8 How have you been involved with the RTO?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
Collaborative research project	70	57	69	71
Member	65	50	62	64
Consultancy	55	64	69	55
Training/conferences/Events	55	43	69	47
Networks	49	36	62	44
Contract research	26	21	38	29
Commercial application / exploitation support	20	29	23	20
Strategic Partnerships/Ventures	16	29	15	15
Other	13	7	15	15
Number of respondents	*91*	*14*	*13*	*55*

Source: PACEC Survey (q17a)

4.2.14 Table 4.9 shows that 79% of surveyed firms do in house R&D, and 65% do R&D collaboratively with a university, indicating that they are a highly innovative sample of UK firms. The numbers are fairly similar for SMEs and large firms.

Table 4.9 What other methods do you use to undertake R&D?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
In house	79	69	83	81
Work collaboratively with RTO	66	54	83	62
Work collaboratively with university	65	54	67	66
Contract out to RTO	51	54	75	49
Contract out to University	42	31	42	**51**
Contract out to consultancy company	31	15	33	38
Work collaboratively with Consultancy Company	25	15	33	25
Work collaboratively with other organisation	22	8	17	28
Contract out to other organisation	19	8	17	25
Other	9	8	17	9
Number of respondents	*85*	*13*	*12*	*53*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q44a)

4.2.15 Table 4.10 shows that 25% of surveyed firms have used R&D tax relief and 41% do not know if they have or not. There is no significant variation between SMEs and large firms, although slightly more large firms do not know if they have used R&D tax relief. This may reflect the more recent introduction of the large firms' scheme.

Table 4.10 Has your firm used Research and Development Tax Credits / tax relief?

	Percentage of all respondents (by number of employees)			
	Total	1 to 50	51 to 250	over 250
No	34	58	42	27
Yes	25	33	25	25
Don't know	41	**8**	33	47
Number of respondents	*80*	*12*	*12*	*51*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC Survey (q45b)

4.2.16 However, less than 5% of the firms (both SMEs and large firms) thought that the scale or nature of their R&D had been influenced by the introduction of R&D tax relief. At the same time, 63% of firms thought that lack of finance was the main constraint on R&D. In addition, 30% of SMEs and 15% of large firms thought there should be more tax incentives for R&D.

4.3 Taxation and incentives

4.3.1 In considering how taxation will affect behaviour we need to ask: (i) how taxation will change the cost (price) of undertaking the activity, and (ii) how individuals will respond to a change in the cost. What we consider below is the impact of taxation on the cost of undertaking the various activities that are undertaken by RTOs. Data is not available to estimate the responsive of RTOs specifically to changes in the cost of their various activities. Therefore, we look to estimates of price responsiveness in the existing literature. Estimates of the own price elasticity of R&D centre around -1.0, suggesting that there is a more or less one for one response to changes in the cost of conducting R&D.[9]

4.3.2 These elasticities have generally been estimated using data on large firms or at the industry level. We asked RTOs how responsive they would be to price changes and their survey responses suggest that they are very unresponsive to price (see paragraph 4.9.1 below). There do not seem to be any obvious reasons why RTOs should be less price sensitive, and it may be that the responses to these questions do not accurately reflect their behaviour. For example, it may be that members and clients decisions on participating in R&D activities are influenced by the cost in ways that are not reflected in the answers given by the RTOs.

[9] See, inter alia, Hall (1993) "R&D tax policy during the 1980s: success of failure" *Tax Policy and The Economy*, 1-35; Hines (1994) "No place like home: tax incentives and the location of R&D by American multinationals" *Tax Policy and the Economy* 8 65-104; Baily and Lawrence (1992) "Tax incentives for R&D: what do the data tell us?" Study commissioned by the Council on Research and Technology, Washington DC; Mamuneas and Nadiri (1996) "Public R&D policies and cost behaviour of the US manufacturing industries" *Journal of Public* Economics 63, 57-81;nd Bloom, Griffith and Van Reenen (2002) "Do R&D tax credits work? Evidence form a panel of countries 1979-1997" *Journal of Public Economics* 85, 1-31.

4.4 Description of the tax model

4.4.1 Our modelling of the impact of S.508, the R&D tax reliefs and other aspects of the tax system on the impact of RTO activities is based on the standard Jorgensen/ King-Fullerton methodology for measuring the impact of tax on the price of investment - the user cost or effective tax rate. This measures how the tax system affects the cost of carrying out a particular activity – specifically it compares the minimum required rate of return for a specific activity in the absence of tax (or in the absence of any part of the tax system) with the minimum required rate of return in the presence of tax.

4.4.2 The standard methodology considers a marginal investment, in other words an investment that just earns the minimum required rate of return, i.e. earns no economic rents. In addition, it is based on the assumption that firms are profit-maximising and that there is perfect competition in product and factor markets. In addition, we assume that investment is financed from retained earnings[10] and that investments are entirely domestic. One way of thinking about this in relation to the behaviour of RTOs is that member firms have a portfolio of projects which they can carry out in a number of different ways - e.g. with in house research facilities, contracting out to a private sector firm, or through involvement in an RTO. One factor affecting this decision, among others, will be the cost. The effective tax rates here give an indication of the way that the tax system affects the variation in cost between the main organisational forms.

4.4.3 The standard expression for the user cost is

$$p = \frac{1-A}{1-\tau}(\rho + \delta)$$

where A is the net present value of all allowances and credits, τ is the statutory tax rate on corporate income, ρ is the real interest rate and δ is the economic depreciation rate of the asset being investment in.[11]

4.4.4 The key factors affecting the return on the investments we are considering are the value of A and the statutory tax rate.

4.4.5 The value of A will depend on the type of investment and the organisational form of the body undertaking the investment. It is composed of at least two parts

$$A = A^C + A^D$$

where A^C is the net present value of the tax credit and A^D is the net present value of tax depreciation allowances. The statutory tax rate varies with the level of profits of the body undertaking the investment (which may be related to organisational form).

[10] We do not consider the impact of the tax system of the cost of raising finance on the equity market or through debt.

[11] The standard King-Fullerton expression subtracts δ from this expression.

4.4.6 The user cost combines a measure of the net present value of allowances and credits with information about other features of the tax system to tell us about how the tax system changes the price of investing an additional pound in that particular asset.

4.4.7 Below we report the 'tax exclusive' effective marginal tax rate, which is

$$\frac{p-r}{r} = \frac{\frac{1-A}{1-\tau}(\rho+\delta)-(\rho+\delta)}{(\rho+\delta)}.$$

4.4.8 A negative EMTR suggests that the tax system provides a subsidy for the activity.

4.4.9 Recent developments in measuring effective tax rates[12] allow for rent earning investments. The measures shown below are based on the assumption of perfect competition in product markets, so it is assumed that a project would only just break even. In order to calculate effective tax rates for rent earning activities a number of further assumptions needs to be made, for example, about the rate of return on investment. We do not believe that we have sufficient information to make meaningful comparisons. However, without doing the full calculations we can comment on the way in which the effective tax rates would change, and we do that below for the rates on large firms' investment decisions. The basic difference in considering the impact of tax on rent earning activities is that, as a project becomes more profitable the costs become smaller relative to profits, so any relief given on costs becomes less important. In the limit, as a project becomes very profitable the effective tax rate tends towards the statutory tax rate.

4.5 Economic parameters

4.5.1 There are two variables that enter the calculation of the user cost that are not driven by the tax system - the assumed economic depreciation rates and the real interest rate (or the investors discount rate).

4.5.2 We consider three main assets: current expenditure, plant and machinery, and buildings and land. A specific investment can be made up of all three of these, for example, ONS statistics suggest that a typical investment in R&D comprises around 90% current expenditure (around half on salaries and around half on consumables) and the other 10% on plant and machinery and buildings and land. These assets will depreciate at different rates. We use a real interest rate of 10%.

4.6 Effective tax rates

4.6.1 We present the effective marginal tax rates (EMTRs) for a variety of activities and organisational forms. We first present EMTRs for R&D activity carried out directly by

[12] See, inter alia, Devereux and Griffith (2002).

a firm or when sub-contracted to a single other firm. We then consider R&D activity funded through non-contractual contributions. This includes members' payments to ERTOs to undertake R&D of common interest. Finally we consider non-R&D activity. In the next section we discuss the implications of the results for incentives to engage in various types of knowledge transfer activity and after that provide direct answers to the questions outlined in the tender document.

4.7 EMTRs on R&D activity

4.7.1 Table 4.11 shows the EMTR for R&D for each principal-subcontractor combination and for each profit band. For simplicity the profit band applies to any profit-making firm involved in the transaction, whether sub-contractor or principal.

4.7.2 The fact that there is substantial variation in the marginal corporation tax rate that depends on the level of profit adds complexity to our modelling strategy. For example a firm making positive profits that are less than £10,000 p.a. would not gain from offsetting further expenditure against tax since its marginal tax rate is zero.[13] This has a particularly marked effect in the context of the SME R&D tax credit, where only a firm with a "surrenderable loss" is able to benefit from the payable aspect of the credit. We discuss this in more detail below.

4.7.3 The first column shows the effects of the tax system on the marginal price to a firm of carrying out its own R&D. For the top profit band, the tax system gives a roughly 20% subsidy to SMEs, a 10% subsidy to large firms, and has no effect on the marginal price of R&D for non-profit bodies. The second column shows the effects of the tax system on the price of R&D subcontracted to a SME, and the third column shows the effects of the tax system on the price of R&D subcontracted to a large firm. The final column shows the effects of the tax system on the price of R&D subcontracted to a non-profit organisation (which includes ERTOs). The EMTRs are the same for sub-contracted R&D as for own R&D except when the principal is a non-profit organisation that is not able to benefit from the R&D tax relief itself.

[13] There are further complications related to the carrying over of allowances to other years.

Table 4.11 Effective marginal tax rate by profit band

Sub-contractor::	Self	SME	Large firm	Non-profit
profit >£1,500,000, 30% marginal tax rate				
Principal:				
SME	-0.204	-0.204	-0.204	-0.204
Large firm	-0.102	-0.102	-0.102	-0.102
Non-profit	0.000	-0.102	-0.102	0.000
profit £300,001 - £1,500,000, 32.75% marginal tax rate				
Principal:				
SME	-0.231	-0.231	-0.231	-0.231
Large firm	-0.116	-0.116	-0.116	-0.116
Non-profit	0.000	-0.116	-0.116	0.000
profit £50,001 - £300,000, 19% marginal tax rate				
Principal:				
SME	-0.111	-0.111	-0.111	-0.111
Large firm	-0.056	-0.056	-0.056	-0.056
Non-profit	0.000	-0.056	-0.056	0.000
profit £10,001 - £50,000, 23.75% marginal tax rate				
Principal:				
SME	-0.148	-0.148	-0.148	-0.148
Large firm	-0.074	-0.074	-0.074	-0.074
Non-profit	0.000	-0.074	-0.074	0.000
profit £0 - £10,000, 0% marginal tax rate				
Principal:				
SME	0.000	0.000	0.000	0.000
Large firm	0.000	0.000	0.000	0.000
Non-profit	0.000	0.000	0.000	0.000
profit < £0				
Principal:				
SME	-0.228	-0.228	-0.228	-0.228
Large firm	0.000	0.000	0.000	0.000
Non-profit	0.000	0.000	0.000	0.000

Source: IFS

4.7.4 The subsequent panels of Table 4.11 show the same values for different profit rates. The same patterns hold when we look across the rows (at different sub-contractors) and when we look down the columns within a profit band. However, when we compare across profit bands the numbers vary due to the different marginal rates of corporation tax.

4.7.5 Figures A1 and A2 in Appendix A show the EMTR for own R&D by profit band and type of organisation. It is clear that the EMTR varies substantially with taxable profits, becoming zero when taxable profits are less than £10,000. The large subsidy for SMEs making negative profits is due to the repayable aspect of the SME credit. (see

Figures A1 and A2, Appendix A). The bottom panel of Table 4.1 shows the EMTR when the relevant firm is making negative profits. It should be noted that the negative numbers are the maximum possible subsidy, since the repayable SME tax credit applies to the lower of the firm's eligible R&D expenditure and its "surrenderable loss". The numbers in the figures and the table thus apply to the situation when the amount of eligible R&D expenditure is smaller than the surrenderable loss.

4.7.6 As explained above, the basic difference in considering the impact of tax on rent earning activities is that, as a project becomes more profitable costs become less important and so the impact of tax relief on costs becomes small and the effective tax rate tends towards the statutory tax rate. If we consider what this would mean for the top panel of Table 4.11, in the limit for a very profitable project the effective average tax rates are given in Table 4.12 under the assumption that all rents go to the principal. In this case non-profit making organisations pay no tax, while others pay tax at the statutory tax rate.

Table 4.12 Effective tax rate in the limit for infinitely profitable R&D project

Sub-contractor:	Self	SME	Large firm	Non-profit
profit >£1,500,000, 30% tax rate				
Principal:				
SME	0.300	0.300	0.300	0.300
Large firm	0.300	0.300	0.300	0.300
Non-profit	0.000	0.000	0.000	0.000

Source: IFS

4.8 Independent R&D activity funded through non-contractual contributions

4.8.1 We now consider the impact of the tax system on firms' incentives to fund independent R&D through non-contractual contributions. This includes R&D performed by a university or by an ERTO through members' contributions. The table below shows the EMTR for R&D for different combinations of the type of firm commissioning the R&D, the type of organisation doing the R&D, and whether the R&D is done under contract or through contributions. For simplicity we also assume that all profit-making firms have positive profits greater than £1,500,000.

4.8.2 The key aspect of the tax system for this analysis is the distinction between the SME R&D tax credit and the large firms credit when it comes to payments to non-profit organisations that fall outside of a contractual framework. These kinds of payments do not qualify for relief under the small firms credit but do qualify under the large firms credit, as long as the R&D is relevant to the firm and the firm is not "connected" to anyone receiving the payments. In addition there is no provision for SMEs to claim relief under the large firms rules in this case. This contrasts for example with R&D

subcontracted by a large firm to a SME, in which case there is a specific statutory provision allowing the SME to claim under the large firm rules.

Table 4.13 EMTRs for R&D done under contract and through contributions

Type of firm commissioning the R&D	Type of organisation doing the R&D	Is the R&D done under contract or through	EMTR
SME	Profit	Contract	-0.204
SME	Non-profit	Contract	-0.204
SME	Non-profit	Contributions	0.000
*Large firm	Profit	Contract	-0.102
Large firm	Non-profit	Contract	-0.102
Large firm	Non-profit	Contributions	-0.102

Notes: We assume all profit-making firms have taxable profits greater than £1,500,000.
* in this case the firm doing the R&D claims the relief. As discussed above, if this is the subsidiary of an SRA that gift-aids its profits to the parent then the tax price of R&D is not affected.

4.8.3 The results show that for SMEs the tax system provides a subsidy for R&D that is done under contract but not for independent R&D funded by non-contractual contributions. For large firms the tax system does not discriminate between the different types of R&D. Thus the tax system currently provides less incentives for SMEs to support independent R&D through contributions than it does for large firms.

4.8.4 At first sight there seems no reason why this anomaly could not be rectified simply by changing the rules of the SME R&D tax relief to be the same as those for large firms in this respect. Thus contributions to independent R&D could be made eligible for R&D tax relief under the SME scheme under the same conditions as in the large firms scheme. The Inland Revenue suggested that the current difference between the two schemes was more likely to be an accidental result of their different histories than the result of a deliberate policy choice.

4.8.5 The intended aim of changing the rules as described in the above paragraph would be both to increase the scale of contributions for R&D by SMEs already making them, and to encourage more SMEs to make such contributions than do at present. Without any evidence on the responsiveness of SMEs to this kind of incentive it is impossible to say what the scale of any such effect would be. However, it seems likely that the latter effect (i.e. increasing the number of SMEs making such contributions) is unlikely to be large without some kind of policy to increase awareness by SMEs of the possibility of making tax-efficient contributions to RTOs in this way. This is because there are likely to be significant information and coordination barriers to increasing the scope of such activity.

4.9 Evidence from the survey of RTOs

R&D tax credits

4.9.1 We now consider the results from the RTOs survey with reference to RTOs self-reported sensitivity to changes in the cost of R&D. As noted above, estimates of the own price elasticity of R&D centre around -1.0, suggesting that there is a more or less one for one response to changes in the cost of conducting R&D. In contrast, most RTOs reported that if the cost of R&D were to increase by 10% (for example because of the removal of a government subsidy) there would be little impact on their R&D activity. A quarter thought it would be zero with a mean of 2-3% less activity (for half of those who estimated it). It was considered that higher costs could in part be passed on over time and/or other cost savings made, and appropriate projects selected more rigorously. Most RTO's were, however, unsure of the expenditure criteria used by other firms. There do not seem to be any obvious reasons why RTOs should be less price sensitive, and it may be that the responses to these questions do not accurately reflect their behaviour, as discussed above.

4.9.2 Although Table 4.14 shows that the use of tax credits among the RTOs is relatively widespread, they report that it has had a very limited effect on the activities of the RTOs.

Table 4.14 Has the introduction in 2000/2 of new R&D tax credits affected your own R&D activity?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Not at all	50	71	38
To a limited extent	15	14	15
To some extent	5	0	8
Don't know/Too early	30	14	38
Number of respondents	*20*	*7*	*13*

Source: PACEC Survey (q63q65)

4.9.3 Where ERTOs report that tax credits have increased their activity this has been because tax credits have made it easier to convince the board to bear the cost or risk of the activity - by reducing the tax-price of R&D the policy results in more marginal projects being undertaken. This corresponds closely to the assumptions underlying the tax modelling.

4.9.4 Use of tax credits by RTO members and clients is felt by RTOs to be very low and to have had a very limited effect on the work RTOs undertake for clients. The higher uncertainty in the case of large firms may reflect the more recent introduction of the large firms scheme.

Table 4.15 Has the introduction in 2000 of new R&D tax credits for SMEs affected the R&D activity you undertake for SMEs?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Not at all	67	75	62
To a limited extent	5	13	0
Don't know/Too early	29	13	38
Number of respondents	*21*	*8*	*13*

Source: PACEC Survey (q64a)

Table 4.16 Has the introduction in 2002 of tax relief for large companies affected activity you undertake for large companies?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Not at all	53	71	42
To some extent	5	0	8
Don't know/Too early	42	29	50
Number of respondents	*19*	*7*	*12*

Source: PACEC Survey (q66a)

4.9.5 The reasons cited for limited take up of tax credits are:

a Using 508 / not compatible with 508 / 508 give greater benefits

b Poor understanding of eligible costs and activities

c Cost / complexity of administration

d Insufficient benefit

4.9.6 Overall the results from the survey of RTOs do not provide sufficient evidence either to support or contradict the results of the tax-modelling. One possibility for the low reported effects is that the introduction of R&D tax relief is still too recent to have had a significant impact on the pattern of firms' interactions with RTOs.

Comparisons between Section 508 and R&D tax credits

4.9.7 The survey of RTOs asks the following question: "If you use S508 and tax credits, which provide the greatest tax benefit?" Since ERTOs can only benefit from R&D tax relief through their subsidiaries as discussed above, it is essentially former ERTOs who could answer this question appropriately. They mainly say 508 provides the greatest benefit, but in practice this is usually a comparison with the less restrictive pre-1998 arrangements. The fact that they have chosen to stop being ERTOs under the current arrangements suggests that the benefits are not enough to outweigh the disadvantages. If they have chosen not to be ERTOs because they are making losses then if they are SMEs they could potentially benefit from the repayable aspect of the SME R&D tax credit. We have no information on whether they do this.

4.9.8 Section 508 organisations were asked to what extent they thought their involvement in some key activities would change if tax exemption under section 508 did not exist. These were scientific research, other research and development, collaboration, and membership services. For the most part it was felt that the other research, collaboration and membership services would continue at the same level. However, all but one of the respondents felt they would undertake less scientific research in the absence of S 508. Scientific research is the main activity that we would expect to be eligible for R&D tax relief in the absence of S.508.

Other aspects of Government Policy towards R&D

4.9.9 The main other aspects of government policy which RTOs reported as affecting their R&D activity (apart from the tax regime) were the overall policy on innovation and procurement policies.

Table 4.17 Are there any aspects of government policy which affect the R&D activity you undertake?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Overall policy /strategy on innovation	100	100	100
Government Procurement policies	91	100	80
Government stimulating the demand side	45	50	40
Skills and Labour Supply	45	50	40
Purchasing Consortia (eg manage EU project)	9	0	20
Bureaucratic	9	0	20
Number of respondents	*11*	*6*	*5*

Source: CBR/PACEC Survey (q77a)

4.9.10 In terms of other comments on improving incentives and funding for R&D, the main suggestions were broadening the scope of activities and eligibility and including formal dissemination activity. However, as discussed above, these activities are less likely to generate spillover benefits than research activities.

Table 4.18 Do you have any other comments and suggestions for stimulating R&D?

	Percentage of all respondents (by S508 Status)		
	Total	ERTO	NERTO
Broaden scope/eligibility for funding	57	75	47
Include formal dissemination and knowledge transfer	43	63	33
Simplify procedures	26	13	33
Greater transparency and stability of support	26	38	20
Strengthen supply side	26	50	13
Increase the tax relief rates	22	13	27
Stimulate more collaborative research	22	38	13
Other	30	25	33
Number of respondents	*23*	*8*	*15*

Source: PACEC Survey (q82a)

4.10 Non-R&D activities

4.10.1 RTOs engage in a number of activities besides directly conducting R&D, as shown in Table 4.3. In this section we show how tax affects the cost of undertaking these non-R&D activities (i.e. all activities that are not eligible for the R&D reliefs). Note, however, that for many of these activities there will be less of a rationale for subsidies. From a tax point of view there is no distinction between these activities, except to the extent that costs represent varying proportions of current expenditure, plant and machinery, and buildings and land. We do not have detailed information on the cost structure of these activities, so we present marginal effective tax rates for each of these types of expenditure separately. The marginal effective tax rate on any specific activity would then simply be the weighted average of these assets (where the weights were the share of each asset in costs).

4.10.2 The table below shows how the effects of the tax system vary across organisational form. We discuss the implications of these results for incentives to undertake knowledge transfer activity, in the final chapter of this report.

Table 4.19 Current expenditure: EMTR

Type of asset:	Current expenditure	Plant and machinery	Buildings and land
Type of organisation:			
SME	0.000	0.073	0.259
Large firm	0.000	0.092	0.259
Non-profit	0.000	0.000	0.000

Notes: all firms are assumed to have taxable profits greater than £1,500,000. The results differ according to the marginal tax rate faced by the firm in a similar to those shown in Table 3.1

4.10.3 The tax system does not affect the marginal price of current non-R&D expenditure for any type of organisation, since profit-making firms are able to deduct 100% of current expenditure from taxable profits. This contrasts with a negative EMTR (i.e. a subsidy) for current expenditure on R&D due to the R&D tax credits as discussed above. The tax system results in a 7% increase in the price of marginal investments in plant and machinery for SMEs, and 9% for larger firms. The difference is due to the 40% first year SME allowance. Non-profit organisations are not affected. The same is true of buildings and land, where all profit-making firms face an EMTR of about 26%. These positive EMTRs for non-R&D capital investments contrast with an EMTR of zero on R&D capital investments, which can be entirely deducted from taxable profits in the first year under the R&D allowance.

5 Conclusions on Specific Aims of the Project

5.1.1 In this final chapter we briefly address the specific questions arising from the study brief as set out in the introduction. The discussion draws out the results of the research set out in the chapters above which examine the role ad impact of RTOs, the impact of the tax incentives and results of the tax modelling. The final section discusses the specific issues raised in the brief.

5.2 The Role of the RTOs

5.2.1 The research shows that the aims of the RTOs, as technology intermediaries, are concerned in broad terms with the development of knowledge and technology, its application and commercial exploitation. The development of knowledge and technology is usually through undertaking pure or scientific research (usually in collaboration), with a more significant input by a minority of RTOs, through to research and development (under contract or through collaboration) for all of the RTOs. Application and exploitation is linked to the R&D and underpinned by a range of consulting, testing, brokerage, and prototyping services. Dissemination occurs at one level through these activities, in the short term via the collaboration activities, through consultancy and the programme of events and publications (including dissemination of knowledge developed by other organisations). Hence RTOs aim to offer services, insights, and ideas, at all stages of the value chain. The majority of RTOs usually provide services for specific or related groups of industrial sectors or in terms of technologies which cut across a range of sectors.

a Sector Coverage. Half of RTOs interviewed have a sector focus. Examples of the main sectors are food and drink, construction, ceramics, clothing and textiles, footwear, motor vehicles and aerospace.

b Technologies. Half of RTOs interviewed have a technology focus. There are usually numerous related technologies. Examples of the technologies are related to joining, chemicals, security systems / software, measurement, testing, and modelling.

5.2.2 The linkages with the research base claimed by all RTOs, including the universities and the Research Councils and institutes, are primarily formed through collaborative research with the use of public sector funds such as Faraday and the LINK programmes. The RTOs usually take the lead in collaborative programmes with the other organisations acting as partners. Linkages also develop through the dissemination of research either publicly or where the universities form part of the RTO membership.

5.2.3 The linkages with companies take several forms. By and large the focus is on large and medium-sized firms. Few have a small firm focus. Membership services, for the 70% of RTOs who provide them usually cover some 400 firms. Collaborative research is undertaken to meet the needs of members (i.e. scientific and R&D) which is disseminated regularly to them. The corporate sector is also significantly involved in the public sector collaborative programmes and the larger EU Framework projects. There are strong links with companies (both members and non members) to shape

and develop services for sub-contract R&D, consulting, brokerage, and testing. This provides a direct link to exploitation. By and large the RTOs exploit their own intellectual property directly through spin-outs and subsidiaries rather than in partnership.

5.2.4 Research with firms shows the RTOs play an important role in facilitating firms to keep abreast of technology and industry developments, network with other firms in the sector or users of technology, and to strengthen technical skills and R&D capabilities. A significant minority of the firms also use RTOs to get new ideas and develop new products/services/processes/materials.

5.3 The Nature of Impact

5.3.1 The impact of the RTOs on commercial innovation comes through the mechanisms of collaborative research (with public and private funds), dissemination of knowledge, and sub-contract research and consultancy leading to exploitation by contracting firms and the RTOs themselves.

a **Collaborative Research**. This avenue via the main public sector funds supports R&D which is relatively close to market. The partnerships involve the public and private sectors who benefit directly. The RTOs claim wider beneficiaries and spillover effects to the wider commercial community. RTOs, because of their relative uniqueness, claim that these activities on which they lead would only occur to a limited extent without their involvement.

The collaborative research primarily for members and the private sector combines scientific research with R&D with the results usually disseminated. RTOs claim that it would be unlikely that the outputs would occur at all without their lead role in the research.

In terms of collaborative research the ERTOs on balance undertook more with private sector funds (including revenue from membership fees) and place greater emphasis on pure/scientific research.

The ERTOs consider that the scientific research they carry out (usually in collaboration) leads to greater R&D collaboration. Without the scientific research they would conduct less R&D and have fewer collaborative activities.

b **Knowledge/Technology Dissemination**. The RTOs play a significant role in dissemination in different ways. In terms of methods a wide range of events and publications are organised. RTOs claim that without their lead role this dissemination would be very limited. The ERTOs tend to organise a greater range of dissemination activities (for members and non-members) and are generally involved in formal dissemination more compared to the NERTOs.

c **Commercial Exploitation**. A significant proportion of the RTOs claim to be involved in commercial exploitation directly themselves. Where they are, the main forms are via spin-offs and subsidiary companies or licensing agreements. The NERTOs used these modes together with joint ventures. One in five of the RTOs recognise that without their involvement the exploitation would probably occur to the same extent. However for most it would be to a limited extent and some of the NERTOs claim it would not happen at all.

d The other form of exploitation where RTOs have a role is where other firms take the lead. Here almost all RTOs maintain that the knowledge and

technology they develop (especially via contract R&D, and consulting) is used in exploitation in some form over time, albeit adapted, if not always successfully. They consider that there are ultimately wider beneficiaries and spill-over effects. This exploitation would not occur to the same extent without RTO involvement or to a limited extent.

5.3.2 For the firms involved, the RTOs are perceived to have a positive impact on technical skills and capabilities and on the firms ability to innovate and adopt new technology. For some firms this has also led to innovation within the firm to the extent that new products/ services or processes have been introduced or existing products/ services and processes have been improved.

5.4 The current system of exemption under Section 508

5.4.1 The current system of tax exemption for ERTOs under Section 508 has a number of disadvantages, which are highlighted by the discussion in Chapter 3. The most obvious are the discretionary nature of the scheme and the associated high administrative and compliance costs. The administrative costs are especially high relative to the reduced size of the scheme following the more restrictive approach taken after 1998. A further disadvantage is the focus on organisational form as well as the nature of activity undertaken. This has resulted in possibly inefficient organisational changes on the part of ERTOs in order to benefit from the tax exemption. In addition, as shown by the tax modelling, following the introduction of the R&D tax credits marginal incentives for investment in R&D are higher for SMEs and large firms than for ERTOs. However, this result is reversed for extremely profitable projects.

5.4.2 In the current context there are potentially two issues relating to ERTO status: first is there any justification for the current arrangements as compared to offering a choice between charitable status or a profit-making firm eligible for R&D tax credits, especially considering the high administrative costs? Secondly, if there is a justification for continuing ERTO status in some form, is there any argument for relaxing the requirements to include a wider range of activities, for example along the lines of the current definition of R&D for tax purposes? We discuss these questions below.

5.5 Results from the tax modelling

5.5.1 The main part of the tax modelling considers the decision of a firm over whether to undertake a marginal pound of spending within an ERTO as compared to within other organisational forms. Another marginal over which we could think about decisions being taken is to consider the group of projects that make up an RTO and consider how the tax system affects the decision over whether to be an ERTO or NERTO. This is addressed in paragraph 5.5.9.

5.5.2 Our conclusions here focus on the effective tax rates for organisations with larger profits since chapter 4 suggested that most current RTOs fall into this category. We

separately consider loss making RTOs. We distinguish between R&D and non-R&D activities as this is the only aspect of tax system that generates substantial variation.

5.5.3 RTO activities can broadly be classified into those that would qualify for R&D tax relief (at most around 20% of their activities), and those activities that would not. The activities of most interest to us are the R&D related activities, as these are the ones where the rationale for government support is greatest. Chapter 4 suggested that research activities were fairly similar across ERTOs and NERTOs, with NERTOs using greater amounts of public sector grant funding. There was some indication that ERTOs have more SME members, although the sample sizes were not sufficient to show a significant difference.

5.5.4 In terms of the impact of the tax system on the cost of carrying out R&D related activities, for projects that are near to just breaking even the tax system provides a subsidy to all forms except those where a non-profit making body (e.g. an ERTO) carries out the R&D itself or subcontracts to another non-profit making body. For projects that are very profitable this comparison would be reversed - non-profits would pay no tax while all other organisational forms would pay tax at the statutory tax rate. This is because the costs become very small in relation to the size of profits and therefore any subsidy on costs becomes trivial in relation to the tax the firm pays on the rents earned.

5.5.5 For loss making RTOs that are SMEs there are substantial advantages to being a NERTO, as the tax reliefs are repayable in the form of the R&D tax credit. In addition, there is no benefit from being an ERTO since they pay no corporate income tax in any case.

5.5.6 The impact of tax on the cost of R&D depends crucially on the marginal rate of corporation tax organisations face, as highlighted in the graphs in the Appendix.

5.5.7 The tax system does not affect the cost of R&D sub-contracted by a large firm to the subsidiary of a non-profit organisation, such as an ERTO, if the subsidiary gift-aids all its profits to the parent. This is not the case for R&D sub-contracted by a SME, in which case the SME claims R&D tax relief. This means that large firms have lower incentives to sub-contract R&D to subsidiaries of ERTOs than SMEs do. We discuss below the likely effects on this conclusion of aligning the S.508 definition of scientific research with that for R&D.

5.5.8 For large firms the impact of tax on the cost of sub-contracted R&D does not depend on whether the R&D is done through a contractual agreement or through contributions to independent R&D. This latter case includes membership payments to an ERTO. The same is not true for SMEs who face a higher cost for R&D done through contributions than for R&D done through a contractual agreement. This reduces SMEs' incentives to contribute to certain forms of collaborative R&D. The IP requirements in the SME R&D tax relief scheme may also reduce SMEs' incentives to fund collaborative R&D where the results will be widely disseminated, although the extent of this effect depends on how the requirements are interpreted in practice.

5.5.9 The framework used to evaluate the impact of taxation on RTOs, which is based on profit-maximising behaviour, may seem at odds with the objectives of some RTOs. However, we can equivalently think of organisations as being cost-minimising. As described above, most ERTOs are structured as an ERTO parent and a NERTO subsidiary. If the requirement to remit a "reasonable profit" to the parent is non-binding, then each individual ERTO faces the decision on each pound spent on scientific research of whether to carry it out in the ERTO, and thus be exempt from tax, or in the NERTO, and be eligible for the tax credit.[14] If, on the other hand the requirement to remit a "reasonable profit" to the parent is binding then the incentives will depend on the level of taxable surplus (profits) generated by the activities (as explained in para 4.4.9). If we consider a set of projects with low rates of return then the tax consequences of being an ERTO will be zero tax compared to a tax subsidy if the firm is a NERTO. On the other hand if the set of projects earn reasonably high rates of return then being an ERTO will still mean no tax liability while being a NERTO will mean being taxed at or near the statutory tax rate.[15]

5.6 Answers to specific questions

"To what extent do current tax exemption/relief measures encourage knowledge transfer?"

5.6.1 We consider a narrow definition of knowledge transfer that includes contract and collaborative research, particularly that involving participants from different industrial sectors and where the results are widely disseminated, at least amongst the collaborators. The current system of exemption from corporation tax under Section 508 encourages some forms of knowledge transfer through the activities of ERTOs. In particular the system encourages the undertaking of "scientific research" that is widely disseminated amongst members. This is narrower than all activities that could be interpreted as knowledge transfer.

5.6.2 For direct contract R&D the tax system does not distinguish between own R&D and R&D contracted to any other organisation. The exception to this is when large firms sub-contract R&D to the subsidiary of an ERTO, in which case R&D tax relief does not change the tax price of the R&D unless the subsidiary does not gift-aid all of its profits to the parent ERTO.

5.6.3 The large firms' R&D tax credit enhances large firms' incentives to contribute to ERTOs' R&D through non-contractual contributions, but this is not true of the SME scheme. We have discussed how this apparent anomaly might be removed. In addition, the IP conditions in the SME scheme could conceivably provide incentives against funding research projects whose results were too widely disseminated.

[14] The ability to withdraw surplus earnings from the organisation will of course also be affected by this decision.

[15] Again, there are clearly implications for the ability to withdraw surplus earnings from the organisation.

5.6.4 Activities such as technology consultancy that could be regarded as constituting knowledge transfer are not specifically encouraged by current measures. In the light of above discussions about the justification for government intervention in knowledge transfer, these types of activities seem less appropriate targets for government support than the research-based activities described above.

"What are the interactions between the tax exemption/relief measures based on the nature of the organisation undertaking the activity and those based on the type of activity undertaken?"

5.6.5 ERTOs cannot benefit from tax relief through the R&D tax credits since they are exempt from corporation tax, but SMEs and large firms can claim under the large firms' scheme for R&D contracted to them by an ERTO. SMEs can claim under the SME scheme for R&D that they sub-contract to an ERTO or its subsidiary, but large firms can only claim relief for R&D sub-contracted directly to an ERTO and not to its subsidiary. For the ERTO to be able to undertake this form of R&D there must be specific conditions in the contract that specify how the results will be disseminated. The subsidiary of an ERTO can claim relief under the large firms' scheme for R&D sub-contracted to it by a large firm, but this does not affect the tax price of the R&D if the subsidiary gift-aids all of its profits to the parent SRA. Large firms can claim relief for contributions to independent R&D performed by an ERTO, but SMEs cannot. This reduces SMEs' incentives to contribute towards this kind of collaborative research compared to large firms.

"What would be the impact of using the definition of R&D used for tax purposes for all R&D exemption/relief measures?"

5.6.6 Using the definition of R&D used for tax purposes to grant S.508 status would reduce complexity by harmonising the different definitions and would lead to a slightly broader class of activities being carried out by ERTOs. However, it is likely to have only a small effect without accompanying changes to the other aspects of the S.508 regime. If the conditions on contractual R&D and dissemination of results were also relaxed there might be quite a large increase in the amount of private contract R&D done for large firms within ERTOs, in order to benefit from R&D tax relief under the large firms' scheme. However, it is not clear that this is the intended purpose of the exemption.

"What are the economically valid boundaries for the use of R&D tax exemption/relief measures?

5.6.7 We have discussed the rationales for government intervention in R&D and knowledge transfer based around the concepts of knowledge spillovers and network spillovers. For collaborative R&D, and especially R&D where the results are widely disseminated, the spillover rationale for intervention is especially relevant. Further rationales apply for some forms of knowledge transfer. For example, collaborative R&D may involve coordination and information failures associated with establishing collaboration arrangements in the first place. This may be particularly true of

collaborations between firms in different industries who share similar technological needs, but who may not naturally meet in the market place. Further network spillovers may justify ongoing support. In contrast, knowledge transfer activities that simply involve testing under existing standards or paying for access to existing information are less likely to be subject to market failures other than inadequate provision of information.

5.6.8 Evidence from the survey of RTOs and firms using RTOs suggests that R&D and collaborative R&D constitute a significant part of RTOs' activities, and that RTOs consider there to be significant spillovers from their activities.

5.6.9 Knowledge spillovers arising from a particular activity justify support for that activity, irrespective of the type of organisation undertaking it. Network spillovers arising from RTOs' activities may justify support for the establishment and upkeep of the relevant network. However, the current arrangements under Section 508 appear to target an activity (scientific research) through a particular organisational form. The aspects of RTOs' activities that most contribute to the establishment of networks may not correspond exactly to those associated with scientific research.

"How valid is the research "spillover" rationale for the application of tax exemption/relief in the value chain from idea to application, with the aim of improving wealth creation through innovation in the UK economy?"

5.6.10 This report has shown that RTOs occupy an important intermediation role in the UK innovation system. They are involved at each of the stages which one might consider in the range of activities from pure research to the management of product and process innovation. We have described the changes in the structure of the organisations in the RTO sector that have been associated with the changes in the interpretation of exemption for section 508 purposes. We have also demonstrated that the interaction between the various components of the tax regime and R&D activity have incentive effects which are compatible with reducing some of the problems that arise from the presence of R&D spillovers generally. We identified more specifically arguments associated with the set up costs for collaborative organisations such as RTOs which could justify seedcorn funding to overcome the gap between the private set up costs and benefits which accrue beyond the set up group. Each of these rationales for exemption will have implications for the 'value chain' since they affect the scale of R&D and interaction between parties at each of its stages. Since RTOs are both sector and technology specialised these effects may be associated with network spillovers where innovative advances require simultaneous developments in disparate sectors or fields.

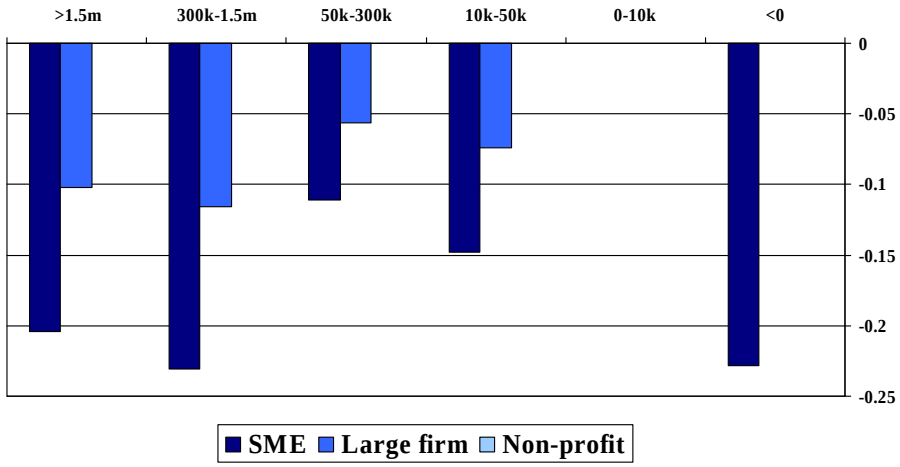
5.6.11 The nature of the value chain is however variable across sectors and across the application of different technologies. It is also affected by a very wide range of government policies ranging from the funding streams for universities to the system of intellectual property rights and the taxation of capital gains. A full discussion is therefore clearly beyond the scope of this report. It is worth noting however that the use of the tax system in relation to value chain issues is best seen as providing an

essentially overarching but complementary backdrop against which more specific innovation policy instruments could be targeted. These would include the five main 'products' around which future DTI policy in this area is to be developed. These products include in particular 'Collaborative R&D' which builds on the LINK programme where we have demonstrated extensive RTO involvement and 'Knowledge Transfer Networks' based on the existing Faraday partnerships where we have also shown positive RTO activity. Value chain impacts arising from the current tax system will therefore be affected by the way in which these products and the other three products (Grant for R&D, Grant for investigating an innovative idea and Knowledge Transfer Partnerships which builds on the Company Teaching Scheme) are developed.

Appendix A Effective Marginal Tax Rates by Firm Types and Profit Band

A1 Figure 1

Figure 1: EMTR for own R&D investment by profit band



A2 Figure 2

Figure 2: EMTR for R&D investment by firm type